



Zootaxa 4185 (1): 001–274
<http://www.mapress.com/j/zt/>

Copyright © 2016 Magnolia Press

Monograph

ISSN 1175-5326 (print edition)

ZOOTAXA

ISSN 1175-5334 (online edition)

<http://doi.org/10.11646/zootaxa.4185.1.1>

<http://zoobank.org/urn:lsid:zoobank.org:pub:0D054EDD-9CDC-4D16-A8B2-F1EBBDAD6E09>

ZOOTAXA

4185

Guide to the Parasites of Fishes of Canada Part V: Nematoda

HISAO P. ARAI^{3,5} & JOHN W. SMITH⁴

³*Pacific Biological Station, Nanaimo, British Columbia V9R 5K6*

⁴*Department of Biology, Wilfrid Laurier University, Waterloo, Ontario N2L 3C5. E-mail: drjohnwsmith37@gmail.com*

⁵*Deceased*



Magnolia Press
Auckland, New Zealand

Accepted by K. DAVIES (Initially edited by M.D.B. BURT & D.F. McALPINE): 5 Apr. 2016; published: 8 Nov. 2016

Licensed under a Creative Commons Attribution License <http://creativecommons.org/licenses/by/3.0>

HISAO P. ARAI & JOHN W. SMITH

Guide to the Parasites of Fishes of Canada. Part V: Nematoda*

(*Zootaxa* 4185)

274 pp.; 30 cm.

8 Nov. 2016

ISBN 978-1-77670-004-2 (paperback)

ISBN 978-1-77670-005-9 (Online edition)

FIRST PUBLISHED IN 2016 BY

Magnolia Press

P.O. Box 41-383

Auckland 1346

New Zealand

e-mail: magnolia@mapress.com

<http://www.mapress.com/j/zt>

© 2016 Magnolia Press

ISSN 1175-5326 (Print edition)

ISSN 1175-5334 (Online edition)

***Editors of the series:**

MICHAEL D. B. BURT & DONALD F. McALPINE

Table of contents

<i>Dedications</i>	4
Preface	5
Abstract	5
Résumé	5
Introduction	6
Collection and Examination of Nematodes	9
Geographical Distribution	10
Glossary of Terms	10
Keys and Descriptions	15
Higher classification of the Phylum NEMATODA	15
Phylum NEMATODA: diagnosis	16
Keys to NEMATODA	17
Keys to Classes of NEMATODA	17
Keys to Orders of the Class ENOPLEA and Subclass DORYLAIMIA	17
Keys to genera of larvae in the Family DIOCTOPHYMATIDAE	18
Keys to Families of the Order TRICHINELLIDA	21
Family CYSTOOPSIDAE	21
Family CAPILLARIIDAE	23
Family TRICHOSOMOIDIDAE	33
Keys to higher taxonomic ranks of the Class CHROMADOREA	34
Keys to Superfamilies of RHABDITIDA	35
Superfamily ANGUILLICOLOIDEA	36
Family ANGUILLICOLIDAE	36
Keys to Families of the Superfamily DRACUNCULOIDEA	37
Family DANICONEMATIDAE	37
Family GUYANEMIDAE	39
Family PHILOMETRIDAE	42
Superfamily GNATHOSTOMATOIDEA	58
Family GNATHOSTOMATIDAE	58
Superfamily OXYUROIDEA	60
Superfamily CAMALLANOIDEA	60
Family CAMALLANIDAE	60
Superfamily THELAZIOIDEA	66
Family RHABDOCHONIDAE	66
Superfamily SPIRUROIDEA	82
Superfamily HABRONEMATOIDAE	83
Family CYSTIDICOLIDAE	83
Family HEDRURIDAE	114
Family TETRAMERIDAE	114
Superfamily ACUARIOIDEA	114
Family ACUARIIDAE	115
Key to Superfamilies of the Infraorder ASCARIDOMORPHA	119
Keys to Families of ASCARIDOIDEA	119
Family ACANTHOCHEILIDAE	119
Family ANISAKIDAE	121
Subfamily RAPIDASCARIDINAE	134
Superfamily SEURATOIDEA	150
Family CUCULLANIDAE	150
Family QUIMPERIIDAE	171
Superfamily METASTRONGYLOIDEA	176
Family PSEUDALIIDAE	176
HOST-NEMATODE PARASITE LIST	178
ACKNOWLEDGEMENTS	224
REFERENCES	224
INDEX to NEMATODE PARASITES	263
INDEX to HOSTS	269

In Memory of

Norma Rose Smith
06 May 1943–21 November 2005
Wife, Mother, Grandmother, Best Friend

Dr Rod Wootten
17 May 1946–08 November 2013
Good Friend, Colleague

Andrew Charles Hood-Morris
01 December 1968–30 August 2013
Good Friend

PREFACE

The current volume, dealing with the nematode parasites of Canadian fresh-water, brackish-water and marine fishes, is part V of a series initiated in 1984 under the editorship of noted Canadian parasitologists Leo Margolis (1927–1997) and Zbigniew “Bob” Kabata (1924–2014). The first four parts dealt with Monogenea and Turbellaria (Beverley-Burton 1984), Copepoda and Branchiura (Kabata 1988), Isopoda (Rafi 1988), Amphipoda (Bousfield & Kabata 1988), Acanthocephala (H. P. Arai 1989), Cnidaria (M. N. Arai 1989) and Trematoda (Gibson 1996). Contributions I to III were published by the Canadian Federal Department of Fisheries and Oceans under the Canadian Special Publications of Fisheries and Aquatic Sciences banner, while part IV was published by the NRC Research Press. We are pleased to provide part V through the journal *Zootaxa*. Our cover design has been adapted from Dr. Greg Klassen’s original artwork for the cover of Part I. The use of this design for volumes II–IV, with modifications tailored to specific taxa, has permitted visual continuity in the series, regardless of the imprint under which the volumes have been published. With a nod of thanks to Dr. Klassen, we have chosen to continue this tradition.

The founding editors recognized the need for “a compendium allowing for relatively easy identification of the parasites of fishes of Canada” and we believe that Hisao P. Arai and John W. Smith (JWS) have ably met that goal for the 88 nematode species included here. Nonetheless, readers will recognize that in a work that seeks to synthesise more than 800 references there may well be errors of omission or commission. While JWS has advised us that he accepts sole responsibility for such errors, as Editors we recognize that we would be remiss in allowing one or both authors to carry this burden alone.

The Editors

Abstract

Keys are provided for the identification of the nematode species known to be parasites of Canadian fishes. The nematodes are described and illustrated, with a note of the site(s) they occupy in named fish host(s) and their geographical distribution. Parasite records are given by author and date, full details of which can be found in a bibliography of over 800 references. Diagnoses and keys for 22 Families, 47 genera and 88 species of nematodes are also given, together with a glossary of terms, a host-parasite list, and indices to both nematode parasites and hosts.

Key words: Nematoda, Dioctophymatidae, Capillariidae, Cystoosidae, Trichosomoididae, Anguilliculoidea, Dracunculoidea, Gnathostomatoidea, Oxyuroidea, Camallanoidea, Thelazioidea, Spiruroidea, Habronematoidea, Acuarioidea, Ascaridoidea, Seuratoidea, Metastrongyloidea, fishes, Canada, biodiversity, nematode parasites, host-parasite list, parasite list, host list

Résumé

Des clés sont fournies pour identifier les de nématodes, connues pour être des parasites de poissons canadiens. Les nématodes sont décrits et illustrés, avec une note de l’endroit, ou des endroits, qu’ils occupent dans les poissons hôtes et leur répartition géographique. Les données sur les parasites sont classées par auteur et date, et les détails se trouvent dans une bibliographie de plus de 800 références. Les diagnoses et les clés de 22 Familles, 47 genres et 88 espèces de nématodes sont également données, ainsi qu’un glossaire de termes, une liste hôte-parasite et un index des parasites et des hôtes.

Introduction

“If all the matter in the universe except the nematodes was swept away, our world would still be dimly recognizable and if, as disembodied spirits, we could then investigate it, we should find its mountains, hills, vales, rivers, lakes and oceans represented by a film of nematodes” Cobb (1915)

Nematodes are probably the most abundant multicellular organisms on earth (Cobb 1915). They vary in size from free-living species less than one millimetre long to *Placentonema gigantissima* parasitic in the placenta of sperm whales that, according to Gubanov (1951), is over eight metres long!

Free-living nematodes occupy the soil, seas, brackish water or fresh water, and some are regarded as “extremophiles” (Wharton 2003). One of them, *Caenorhabditis elegans*, was the first animal to have its entire genome sequenced (Hodgkin *et al.* 1998). Some plant-parasitic species are economically important as pests of crops (Lee 2002). Nematodes are also parasites of animals, including some from humans that have been known from antiquity. For example, Gibbons (2010) noted that nematodes are mentioned in the Egyptian *Papyrus Ebers* as early as *circa* 1550 BC. The “Staff of Aesculapius with Serpent Entwined” and the “Caduceus with Double Serpents” are universal symbols of medical and pharmaceutical services; both symbols evoke the time-honoured method of extracting female guinea worms, *Dracunculus medinensis*, from the lower limb of humans (Old Testament, Numbers 21: 6–9).

This part of the Guide series concerns the identification of larval and adult nematodes of fishes inhabiting all of Canada’s diverse aquatic environments. In an introduction to Part I of the Guide series the then Editors Margolis & Kabata (1984) indicated that the various parts are intended for fish parasitologists and for those concerned with fish and human health.

Wild and farmed fish species are important sources of protein for human consumption and are likely to remain so in the future (Greenberg 2010), so the safety of such products is important. Indeed, the larvae of some marine anisakid nematodes (species of *Anisakis*, *Pseudoterranova* and *Contracaecum*) have considerable public health and commercial significance (J. W. Smith & Wootten 1978; Bowen 1990; J. W. Smith 1999; Hochberg & Hamer 2010). A recent Canadian report by S. Vaughan *et al.* (2015) is pertinent. A 50-year-old Albertan man suffered severe epigastric pain one hour after eating raw wild salmon that evidently contained anisakid larvae; endoscopy subsequently revealed several larvae in his stomach mucosa. Earlier Canadian and other North American examples of accidental infection of humans with larval marine anisakids were summarised by J. W. Smith (1999) in a worldwide review of pathology associated with ascaridoid infection of the alimentary tract of vertebrates, including humans.

Agnathan fishes contribute significantly to the fish fauna of Canada (www.fishbase.org) so a brief review follows: it relies heavily on the host-parasite lists provided in the various parts of this Guide. Lampreys (Petromyzontiformes) have been recorded with nematodes (pages 153–155, 178) and with copepods, acanthocephalans and digeneans (Kabata 1988; Arai 1989; Gibson 1996). Hagfishes (Myxiniiformes) in Canada comprise *Myxine glutinosa*, *Eptatretus deani* and *E. stoutii*, the host roles of which appear neglected because hagfish species are not listed anywhere in the Guide series. Parasitological examination of Canadian hagfishes might be rewarding because Luo *et al.* (2016) reported anisakid nematodes in *Eptatretus* from Taiwanese waters, and monogeneans were reported on *Eptatretus* from Californian and South African waters by Malmberg & Afzelius (1990) and D. B. Vaughan *et al.* (2010).

From an environmental viewpoint, nematodes and other macroparasites of fishes might serve as biological indicators in assessing climate change and attempts to ameliorate its effects (Palm 2011), especially as water supplies are likely to become a universal priority (Radkau 2014).

The *CIH Keys to the Nematode Parasites of Vertebrates* and other major works on nematode taxonomy and systematics were consulted during preparation of this part of the Guide. Spencer Jones & Gibson (1987) updated the *CIH Keys* that had originally appeared in 10 parts under different authorship between 1974 and 1983 (see Anderson 1978; Anderson & Bain 1976, 1982; Anderson *et al.* 1974; Chabaud 1974, 1975a,b, 1978; Durette-Desset 1983; Hartwich 1974; Lichtenfels 1980a,b; Petter & Quentin 1976; Willmott 1974). The publication by Anderson *et al.* (2009) of an “Archival Volume” for the *CIH Keys* was followed by Gibbons’ (2010) “Supplementary Volume” that brought together the various parts, drew attention to new taxa described after the originals were completed, and attempted to identify the current position of some of the older taxa excluded from the original *Keys*. Superfamilies and the arrangement of Families within them in this part of the Guide are generally as recommended in the *CIH Keys* with one exception: Moravec’s (2001) keys to Families in the Trichinelloidea Ward, 1907, are followed, including recognition of the Family Capillariidae Railliet, 1915, rather

than Trichuridae (Ransom, 1911) Railliet, 1915. Following proposals by Hartwich (1974, 1975) raphidascaridids are treated not as a Family (Raphidascarididae—see De Ley & Blaxter 2002) but as a Subfamily (Raphidascaridinae) within the Family Anisakidae.

Holotypes and other type material of nematode taxa of Canadian origin are deposited in one or more curatorial facilities in Canada and sometimes elsewhere. Much Canadian material is housed at the Canadian Museum of Nature, Ottawa, Ontario. The Museum holds some 50,000 lots, including many specimens originally stored at the Institute of Parasitology (McGill University, Sainte-Anne-de-Bellevue, Québec) and the former Arctic Biological Station (Fisheries and Oceans Canada). Type material and voucher specimens may also be lodged at any of the provincial museums and associated institutions listed on the website of the Alliance of Natural History Museums of Canada:

The United States National Collection of Parasites (USNCP) also contains some Canadian type materials. The USNCP, established in 1892 and curated for over 70 years at the Beltsville Area Research Center (Maryland), was transferred in 2013 to the Smithsonian Institution, National Museum of Natural History (Washington, DC, USA).

Attention is drawn to the records herein of *Syncyaria squamata* (Acuarioidea: Acuariidae) and *Pharurus pallasii* (Metastrongyloidea: Pseudaliidae). Inclusion of these nematode species is based solely on experimental infection of fishes; see pages 116–118, 176–177 for further details. Firm evidence that fishes serve as paratenic or intermediate hosts for either of these species in Canadian waters currently appears to be lacking.

Particularly noteworthy contributions to this part of the Guide that have appeared in recent years include descriptions of *Huffmanella canadensis* (Trichosomoididae: pages 34–35), gravid females of *Philometra rubra* (Philometridae: pages 49–50) and the invasive species *Anguillicola crassus* (Anguillicolidae: page 37–38). These nematodes are pathogenic to Canadian fishes and/or have commercial importance. Further information is given below and by Moravec *et al.* (2005) and Moravec (2006) for *H. canadensis*, by Moravec *et al.* (2009a, 2013) for *P. rubra*, and by Wjová *et al.* (2006), Aieta *et al.* (2009), Rockwell *et al.* (2009), Campbell *et al.* (2013), Denny *et al.* (2013) and Li *et al.* (2015) for *A. crassus*.

Studies based on DNA have provided significant insights into relationships between groups within the Phylum Nematoda. For example, recent evidence suggests that Clade III nematodes comprise the orders Gnathostomatomorpha, Ascaridomorpha, Oxyuridomorpha, Rhigonematomorpha and Spiruromorpha (Blaxter *et al.* 1998; Nadler & Hudspeeth 2000; Nadler *et al.* 2007; Laetsch *et al.* 2012). More recently, Choudhury & Nadler (2016) reported on the phylogenetic relationships of Cucullanidae, and appealed for greater scrutiny of the conventional classification of the superfamily Seuratoidea. Evolutionary relationships between nematodes and other animals have also been explored (Blair *et al.* 2002; Dunn *et al.* 2008). Ribosomal and mitochondrial sequences including barcodes (Hebert *et al.* 2003; Ferri *et al.* 2009; Packer *et al.* 2009) have proven especially useful in alpha taxonomy (Miller 2007; Schlick-Steiner *et al.* 2010). DNA and allozyme data are particularly valuable in studies requiring species level identification of larval stages or in investigations of cryptic species where morphological criteria alone do not permit identification to species level. For example, some species of *Anisakis*, *Pseudoterranova* and *Contracaecum* appear to be composites of cryptic species that show differences in geographical range and final hosts (Mattiucci *et al.* 1998; Paggi *et al.* 2000; Mattiucci & Nascetti 2007, 2008).

Unfortunately, there are significant gaps in the availability of molecular data for the broader nematode fauna of fishes in general and for Canadian ones in particular. Thus, only 29 (about 62%) of the 47 genera in this part of the Guide are represented in GenBank (Table 1). These include sequences of 161 named species or members of species complexes (e.g. *Anisakis*, *Pseudoterranova* and *Contracaecum*) and sequences for another 272 identified only to genus; 236 (about 87%) of these are unidentified specimens of *Anisakis*, *Hysterothylacium* and *Eustrongylides*, all of which are common as larval stages in fishes. Only 15 (about 31%) of the 47 genera included in this part of the Guide are represented in GenBank (19 species with one to three species per genus). No doubt more sequence data will accumulate over time but studies on fish nematodes will continue to depend heavily for the foreseeable future on morphology-based identifications. The universal shortage of “classical” parasite taxonomists and systematists (Brooks & Hoberg 2001; Poulin & Leung 2010; Šlapeta 2013; Scholz & Choudhury 2014) is therefore particularly regrettable.

Not surprisingly, DNA-based studies over the past several decades have also led to significant improvements in our understanding of fish systematics. Therefore, users of this Guide will find in the older literature cited here that the host scientific names used by authors are sometimes not those now in use. For the scientific names of fishes we have followed the nomenclature of Page *et al.* (2013). We refer to the on-line resource FishBase (www.fishbase.org) for fishes from depths greater than 200 m, that is, in areas not dealt with by Page *et al.* (2013).

TABLE 1. Nematode genera for species of which sequence data are available in GenBank (accessed 31 March 2014) and for which keys to species are provided in this part of the Guide.

	Number of sequences of species in each genus in GenBank		Number of species in the Guide with sequences in GenBank	Species in the Guide with sequences in GenBank
	Identified species	unidentified species		
<i>Anguillicola</i>	5	0	1	<i>A. crassus</i>
<i>Anisakis</i>	13	64	1	<i>A. simplex</i>
<i>Ascarophis</i>	2	0	1	<i>A. arctica</i>
<i>Caballeronema</i>	0	0	0	none
<i>Camallanus</i>	7	3	1	<i>C. oxycephalus</i>
<i>Capillaria</i>	7	5	0	none
<i>Capillospirura</i>	0	0	0	none
<i>Clavinema</i>	1	0	0	none
<i>Contracaecum</i>	37	19	3	<i>C. osculatum</i> <i>C. rudolphii</i> <i>C. spiculigerum</i>
<i>Cosmocephalus</i>	0	0	0	none
<i>Cucullanellus</i>	0	0	0	none
<i>Cucullanus</i>	3	2	0	none
<i>Cystidicola</i>	2	0	2	<i>C. farionis</i> <i>C. stigmatura</i>
<i>Cystoopsis</i>	1	0	0	none
<i>Daniconema</i>	0	0	0	none
<i>Dichelyne</i>	1	0	0	none
<i>Diectophyme</i>	1	0	1	<i>D. renale</i>
<i>Eustrongylides</i>	1	82	0	none
<i>Haplonema</i>	0	0	0	none
<i>Hedruris</i>	1	0	0	none
<i>Huffmanella</i>	0	0	0	none
<i>Hysterothylacium</i>	11	90	1	<i>H. aduncum</i>
<i>Ichthyofilaria</i>	0	0	0	none
<i>Metabronema</i>	1	1	0	none
<i>Oncophora</i>	0	0	0	none
<i>Paracapillaria</i>	0	0	0	none
<i>Paracuaria</i>	0	0	0	none
<i>Paraquimperia</i>	1	0	0	none
<i>Pharurus</i>	0	0	0	none
<i>Philometra</i>	25	4	1	<i>P. rubra</i>
<i>Philometroides</i>	9	0	0	none
<i>Philonema</i>	1	1	1	<i>P. oncorhynchi</i>
<i>Phocascaris</i>	2	1	0	none
<i>Piscicapillaria</i>	0	0	0	none
<i>Pseudanisakis</i>	1	0	0	none
<i>Pseudocapillaria</i>	0	0	0	none

.....continued on the next page

TABLE 1. (Continued)

	Number of sequences of species in each genus in GenBank		Number of species in the Guide with sequences in GenBank	Species in the Guide with sequences in GenBank
	Identified species	unidentified species		
<i>Pseudodelphis</i>	0	0	0	none
<i>Pseudoterranova</i>	7	0	2	<i>P. bulbosa</i> <i>P. decipiens</i>
<i>Raphidascaris</i>	5	0	1	<i>R. acus</i>
<i>Rhabdochona</i>	10	0	0	none
<i>Salmonema</i>	1	0	1	<i>S. ephemeridarum</i>
<i>Salvelinema</i>	0	0	0	none
<i>Spinitectus</i>	3	0	1	<i>S. carolini</i>
<i>Spiroxys</i>	0	0	0	none
<i>Syncuaria</i>	0	0	0	none
<i>Tetrameres</i>	1	0	0	none
<i>Truttaedacnitis</i>	1	0	1	<i>T. truttae</i>
Totals	161	272	19	19

Collection and examination of nematodes

Thorough search of the tissues and organs of individual fish is recommended in view of the great variety of sites (*sensu* Bush *et al.* 1997) that may be occupied by nematodes. Ideally, live specimens should be collected from freshly-killed hosts and processed immediately. Worms should be dissected free from capsules of host origin, and freed from any host debris by vigorous shaking in physiological saline. Recipes for fresh-water and marine saline are given by Hoar & Hickman (1975). Nematodes collected from long-dead and unprocessed fish, from frozen and then thawed fish, or from fish preserved in formaldehyde for example may yield useful material. However, the body of such worms may be contorted such that examination for features of significance for identification is difficult or impossible.

Larvae of marine ascaridoids that mature in fish-eating birds or mammals (cormorants, gulls, seals, cetaceans, etc) may be recovered from fishes by pepsin/trypsin-HCl digest (for technique see J. W. Smith & Wootten 1975). Such larvae represent species of *Anisakis*, *Pseudoterranova*, *Contracaecum* and *Phocascaris*. At high temperatures the digest technique might not work for larvae that mature in poikilothermic vertebrates as they may not survive the digestion process. However, the digest technique can be used with poikilothermic hosts at lower temperatures, the process merely taking longer.

Records should be kept of the distribution (geographical locality) and number of fish of a given species examined and the number infected with given nematode species. Such information, together with the number of worms found in individual fish, yield valuable epidemiological data such as the prevalence and intensity of infection (Bush *et al.* 1997).

Berland (1970), Pritchard & Kruse (1982), Dailey (1996) and Moravec (2011, 2013) discussed the merits and demerits of various techniques for processing nematodes for identification. Fixation in hot (about 60° C) 70% ethanol works well, at least on large specimens, the worms dying in an extended state. They may then be preserved in 70% ethanol with added glycerine for long-term storage. If the ethanol evaporates over time the specimens remain pliable, and fresh 70% ethanol may be added. Nematodes may also be fixed in hot 10% buffered formaldehyde, and transferred subsequently to 70% ethanol; this technique allows processing for scanning electron microscopy (SEM) and histology, and also for clearing in glycerine-ethanol or lactophenol. Given the importance of molecular data for modern taxonomy, a subsample of nematodes should be fixed and stored in 95% or 100% ethanol that lack harmful additives like methanol, ketones or acetates (Naem *et al.* 2010). Because delicate

nematodes may collapse into unrecognizable wisps after prolonged storage in 95% ethanol they may be fixed for short-term storage (weeks to a few months) in 70% or 80% ethanol, and portions used for molecular work or morphological observations. Specimens that have been frozen or fixed in formaldehyde (or any other agent) may be transferred to 70% glycerine-ethanol for subsequent preservation.

Before microscopical examination large nematodes should be cleared in lactophenol; such treatment renders the specimens translucent for study of internal morphological features of significance for identification. After examination the specimens may be returned to glycerine-ethanol. For delicate nematodes lactophenol should be used with caution as it may lead to their collapse. Delicate worms may be cleared in a solution of 5% glycerine and 70% ethanol, allowing the ethanol to evaporate gradually over several days at room temperature. Then the cleared specimens may be mounted on a slide using the residual glycerine; use of fresh glycerine should be avoided as it may be a higher concentration than the residual glycerine and specimens may collapse owing to unequal osmotic pressure. Along these lines, Moravec (2001, 2013) discussed the best approaches to fixing small worms like capillariids, including their subsequent “elusiveness” in, and retrieval from, vials of preservative. One method is to mount them on slides under coverslips as semi-permanent preparations. Permanent preparations of nematodes are not recommended as it is difficult (or impossible) to rotate the specimens to view significant morphological features. If worms become distended in certain fixatives, and if sufficient material is available, it is useful to fix some in other agents to compare the effects.

Identification of species of certain genera, *Rhabdochona* and *Cystidicola* for example, require dissection of mature eggs from the female’s body to allow examination for filaments and other superficial structures.

En face views of nematodes have been considered to be of taxonomic value but their use in the present work is restricted for the following reasons. Taking the cystidicolid genus *Spinitectus* as an example, Jilek & Crites (1982c) pointed out that some workers have omitted descriptive details of the head or have provided incomplete or misleading *en face* drawings. Scanning electron microscopy (SEM) may provide accurate representations of nematode head anatomy, tail anatomy and cuticular ornamentation but this technology is not readily available to field workers for whom this Guide is mainly intended.

Geographical distribution

A list of jurisdictions, arranged alphabetically, from which nematodes of fishes have been recorded in Canada is provided. The jurisdictions include five broad geographical regions (Atlantic—AT, Canada—CA, Central Canada—CC, Hudson Bay Drainage—HBD, Pacific—PA), where authors have not reported the site of their investigations more specifically. Otherwise we list distribution by political jurisdictions as follows; Alberta—AB, British Columbia—BC, Labrador—LB, Manitoba—MB, New Brunswick—NB, Newfoundland (Island only)—NF, Northwest Territories—NT, Nova Scotia—NS, Nunavut—NU, Ontario—ON, Prince Edward Island—PE, Quebec—QC, Saskatchewan—SK, Yukon—YT. Experimental infections (EX) carried out at Canadian laboratories are also included, although in some cases the geographical source of the parasite material is not stated. Nevertheless, such papers often contain important morphological descriptions and life-history information.

Glossary of terms

By kind permission of the Commonwealth Agricultural Bureau International (CABI) the following Glossary of Terms, including Figures 1 to 14, has been adapted from that given by Dr Sheila Willmott in Anderson *et al.* (1974). New entries are marked with a dagger (†). Inconsistencies in terminology should be noted—see, for example, pharynx/oesophagus and buccal capsule/cavity in Gibbons (2002). Some entries have been modified in the light of recent advances in our understanding of nematode systematics and phylogeny.

ala: alae (plural)	thin, cuticular projection or fin, running longitudinally, usually lateral or sublateral, frequently paired: <i>cervical alae</i> are confined to the anterior end; <i>caudal alae</i> occur on the posterior end of males
amphidelphic	having two opposed sets of female reproductive organs, one extending anteriorly, and the other posteriorly to the vulva

amphids	pair of glandular sensory organs situated laterally in the cephalic region and opening through the cuticle—see Fig. 8
annulations	deep, transverse grooves occurring at regular intervals in the cuticle giving the body a segmented appearance—see Fig. 1
annules	the intervals or rings of cuticle between the annulations—see Fig. 1
area rugosa	ornamentation of the cuticle, sometimes present on the ventral surface in front of the cloaca on the coiled part of the posterior extremity of the male—see Fig. 2

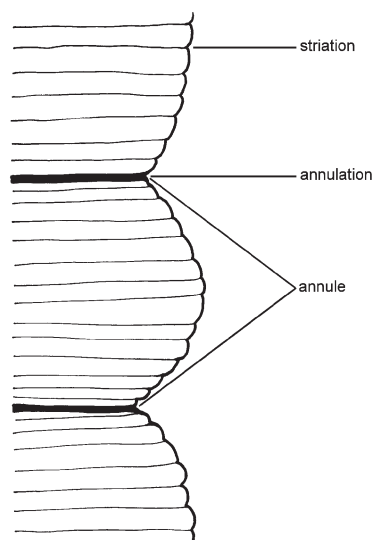


Fig. 1

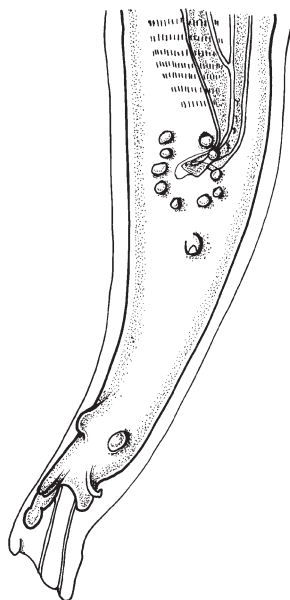


Fig. 2

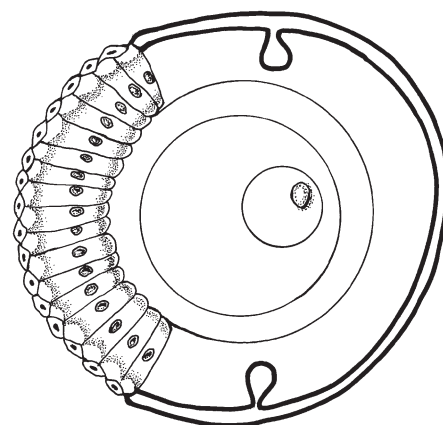


Fig. 3

†aspinose	lacking spines
bacillary band	a modification of the hypodermis in Trichinelloidea, consisting of longitudinal rows of columnar cells that have pore-like openings to the surface of the cuticle (= hypodermal glands of some authors)—see Fig. 3
bacillary layer	a non-vibratile form of ciliary lining of the intestine—see Fig. 4
ballonets	cuticular inflations in the cephalic region assuming a swollen band-shape immediately posterior to the lips (= head bulb of some authors)
bosses	small, round or oval, blister-like inflations of the cuticle
buccal cavity	part of digestive canal between mouth opening and oesophagus; the stoma
buccal capsule	anterior enlarged portion of the buccal cavity with heavily sclerotized walls
bulb	posterior part of muscular oesophagus, generally swollen, containing a valvular apparatus—see Fig. 11
<i>bursa copulatrix</i> (= copulatory bursa)	modified caudal ala or alae found in males of some nematodes, may be circular or oval, often divided into two symmetrical or asymmetrical lateral lobes, separated by a dorsal lobe, and supported by rays or papillae—see Fig. 5
caecum (= intestinal caecum)	a blind diverticulum or pouch from the intestine—see Fig. 6
cardia	oesophago-intestinal valve
cephalic papillae	see under “head papillae”
cervical	applied to structures connected with the “neck” region
cheilorhabdion	wall of cheilostom(e)
cheilostom(e)	first portion of the buccal cavity of a rhabditid-like nematode
circumoesophageal	encircling the oesophagus
circumoral	encircling the mouth

circomyarian
 claviform
 cloaca
 coelomyarian

a type of muscle cell in which the muscle fibre completely surrounds the sarcoplasm
 club-shaped
 the common chamber into which the intestinal and genital canals open
 body musculature consisting of cells of which the internal non-contractile part is well developed and protrudes into the pseudocoelom; the muscle fibres extend to the sides of the muscle cells for varying distances—see Fig. 7

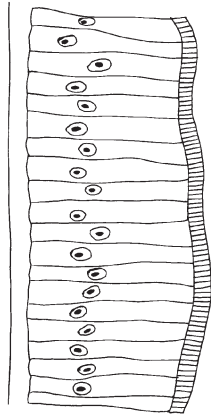


Fig. 4



Fig. 5

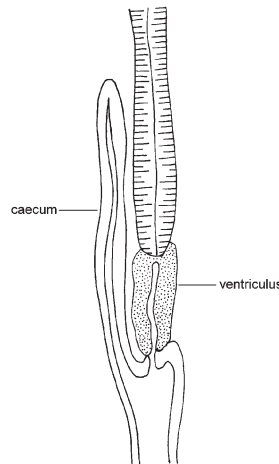


Fig. 6

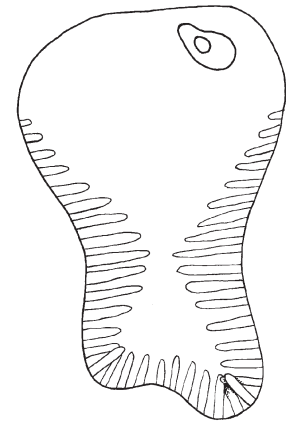


Fig. 7

copulatory bursa
 cord (chord)
 cordon

see *bursa copulatrix*
 dorsal, ventral or lateral longitudinal thickenings of the hypodermis
 longitudinal, cuticular cord-like thickening extending posteriorly from the mouth and may be straight, recurved or form loops, present mainly in the acuarioid Family Acuariidae

corona radiata

the border of the labial region divided into a series of leaf-like structures, found in certain strongyles. There may be two circles of leaf-like structures termed the internal and external corona (= internal and external leaf crowns of some authors)

corpus

anterior end of the oesophagus, often separated from the posterior bulb by the isthmus—see Fig. 11

deirids

a pair of sensory organs found laterally in the cervical region and usually protruding above the surface of the cuticle (= cervical papillae of some authors)

didelphic

with two sets of female reproductive organs

diorchic

with two testes

diverticulum

a tube or sac, blind at distal end, branching off from a canal or cavity

epaulets

specialized, ribbon-shaped, paired bands of cuticle at anterior end (= cordons of most authors)

genital papillae

tactile papillae or setae in the anal region of the male which may be pre-cloacal, post-cloacal or caudal in position (see also pedunculated papillae, plectanes, rosettes)

gubernaculum

an accessory male copulatory piece which is formed by sclerotization of the dorsal wall of the spicule pouch, variable in shape but generally with incurved margins

head papillae

tactile sense organs usually located on the lips or labial region, including two circles of six labial papillae and one circle of four cephalic papillae—see Fig. 8.
cephalic papillae—outer circle of four head papillae (= latero-ventral and latero-dorsal of Chitwood & Wehr 1934)—see Fig. 8.

Externo-labial papillae—median circle of six head papillae (= dorso-dorsal, ventro-ventral and ventro-lateral of Chitwood & Wehr 1934)—see Fig. 8.

Interno-labial papillae—inner circle of six head papilla—see Fig. 8

†hemizonid

a band of highly refractive tissue near the excretory pore formed by subventral commissures connecting the nerve ring to the ventral nerve cord

†hologonic	condition in which germ cells proliferate throughout the length of an ovary or testis (<i>cf</i> telogonic)
interlabia	cuticular outgrowths (neoformations) originating at the base of the lips or pseudolabia and extending between them, occurring in some ascaridids and spirurids

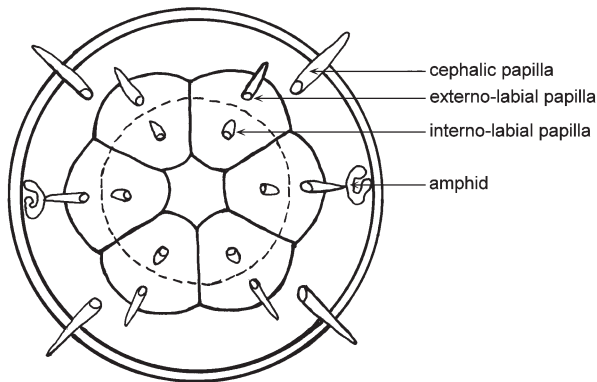


Fig. 8

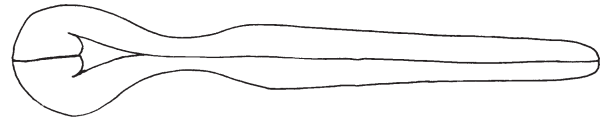


Fig. 9

isthmus	middle part of a muscular oesophagus, often constricted—see Fig. 11
labia	lobes or lips (primitively six) which surround the mouth
†mesostom(e)	third portion of the buccal cavity of a rhabditid-like nematode
†metastom(e)	fourth portion of the buccal cavity of a rhabditid-like nematode
monodelphic	with one set of female reproductive organs
monorchic	with one testis
†mucron	terminal tail spine
oesophago-intestinal valve	situated at opening between the oesophagus and intestine (= cardia of some authors)
†oesophastom(e)	portion of the buccal cavity (stoma) surrounded by oesophageal tissue
opisthodelphic	uteri parallel, directed posteriad
ovijector	part of the female genital system between the end of the uterus and the vulva, modified
(also spelt ovejector <i>in litt.</i>)	to aid in the expulsion of eggs
oxyuroid (or bulboid)	cylindrical anteriorly and terminating in a basal bulb—see Fig. 9
oesophagus	
pedunculated papillae	modified, stalked, genital papillae in cloacal region of male
pharynx	narrow, posterior part of the buccal cavity with thick sclerotized walls
phasmids	pair of glandular sensory organs situated laterally in the caudal region and opening to the surface by a slit or pore
plaques	cuticular “warts”
platymyarian	body musculature consisting of cells not protruding individually into pseudocoelom—see Fig. 10
plectanes	cross striated cuticular plates functioning as supports for the genital papillae in some males
polydelphic	with more than two sets of female reproductive organs
pre-cloacal (pre-anal)	ventral, pre-cloacal structure, sucker-like in form
sucker	
preventriculus	proximal portion of the alimentary tract that, together with the ventriculus, comprises the oesophagus
prodelphic	uteri parallel, directed antieriad
prostom(e)	second portion of the buccal cavity of a rhabditid-like nematode
pseudobulb	muscular swelling of the oesophagus without valvular arrangement
pseudolabia	cuticular outgrowths (neoformations) arising around mouth opening and which, during development, overlie and then replace the primitive lips. The anterior extremity of numerous Rhabditida has two lateral pseudolabia (= probolae of some authors)

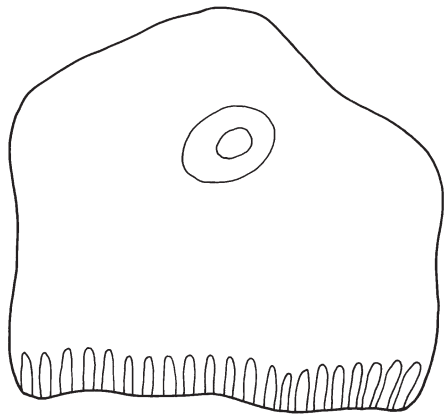


Fig. 10

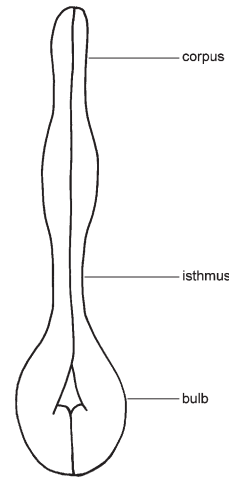


Fig. 11

rays	genital papillae and their accompanying muscles embedded in the bursa of some males
rhabditoid (rhabditiform)	
oesophagus	oesophagus consisting of two swellings, one forming the end of the corpus, the other posteriorly forming the bulb. The region between the corpus and the bulb is known as the isthmus—see Fig. 11
ridges	raised cuticular areas which run the length of the body, very pronounced in some trichostrongyloids—see Fig. 12
rosettes	punctuation patterns of cuticle surrounding genital papillae
sarcoplasm	cytoplasm of any muscle cell
spicule	sclerotized, accessory copulatory organ of male nematodes, usually paired but sometimes single
stichocyte	glandular oesophageal cell not incorporated into oesophageal tissue—see Fig. 14
stichosome	collection of stichocytes arranged in a longitudinal row—see Fig. 14
stoma	see buccal cavity
striations	fine transverse grooves occurring at regular intervals—see Fig. 1
strongyloid (filariform)	slender, cylindrical, without bulb—see Fig. 13
oesophagus	
supplements	in males, ventro-median papillae anterior to cloaca, as well as an ad-cloacal pair of papillae in some nematodes
synlophe	the ensemble of enlarged longitudinal or oblique cuticular ridges which serve to hold the nematodes in place on the gut wall, found in numerous trichostrongylids
telamon	slightly sclerotized, immovable formation of complicated shape in the ventral and lateral cloacal walls that also aids in directing the spicules during copulation
†telogonic	condition in which germ cells proliferate only from the blind proximal end of an ovary or testis (<i>cf</i> hologonic)
telostom(e)	most posterior (fifth) portion of the buccal cavity of a rhabditid-like nematode
trichuroid oesophagus	narrow muscular tube with associated glandular stichosome made up of stichocytes—see Fig. 14
trophosome	reserve organ formed by the transformation of the digestive canal; often appears to be syncytial
ventriculus	glandular modification of the distal portion of the oesophagus of some nematodes; it may have a solid appendage of varying length extending posteriorly dorsal to the intestine (ventricular appendix)
†vestibule	anterior portion of buccal cavity

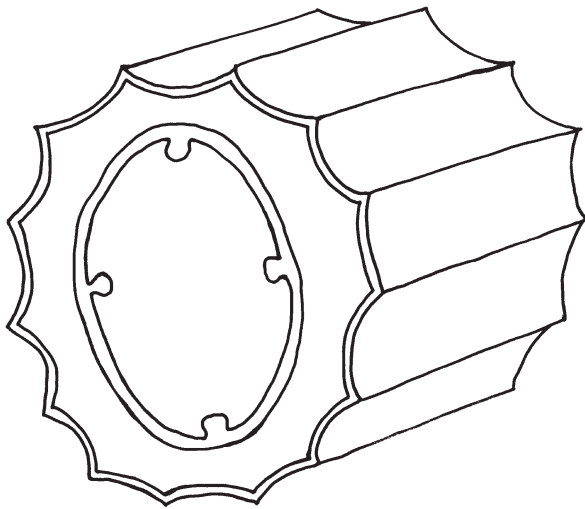


Fig. 12



Fig. 13

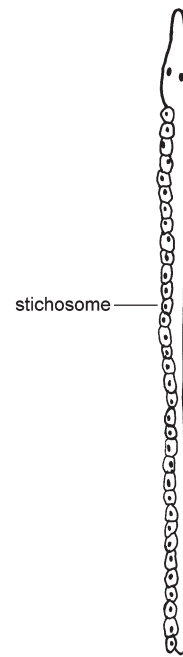


Fig. 14

Keys and descriptions

For reasons beyond the writers' control, it was impossible to standardise the format of keys and descriptions. For example, the descriptions of only some species warrant a preamble and/or subsequent comments. Furthermore, only ranges in length are given in the original descriptions for most species. For those few species where measurements of the holotype, a paratype or an allotype were provided, these are given in parentheses. It is also relevant to note that some nematode species are relatively rare, and that males are unknown for certain philometrids.

Measurements are given in mm unless otherwise stated. Readers should note that the scale bars given for some illustrations are in μm or cm rather than mm, and that some Figures lack scale bars because they were not provided in the original description.

Nematode and other taxonomists have used a variety of styles to illustrate new taxa. Efforts have been made here to standardise the manner in which some organs are portrayed in the Figures—the muscular oesophagus, glandular oesophagus, intestine, and nerve ring in particular.

Those Figures where only the vaginal/vulvar region is illustrated bear the abbreviation “ant” for anterior in the appropriate place lest the anterior-posterior orientation of a female worm is in doubt.

HIGHER CLASSIFICATION of the PHYLUM NEMATODA POTTS 1932, ACCORDING to De LEY & BLAXTER 2002

(Only those Families with representatives parasitic in Canadian fishes are included)

Class Enoplea Inglis, 1983

Subclass Dorylaimia Inglis, 1983

Order Dioctophymatida Baylis & Daubney, 1926

- Suborder Dioctophymatina Skryabin, 1927
 - Family Dioctophymatidae Castellani & Chalmers, 1910
- Order Trichinellida Hall, 1916
 - Superfamily Trichinelloidea Ward, 1907
 - Family Capillariidae Railliet, 1915
 - Family Cystoosidae Skryabin, 1923
 - Family Trichosomoididae Hall, 1916
- Class Chromadorea Inglis, 1983
 - Subclass Chromadoria Pearse, 1942
 - Order Rhabditida Chitwood, 1933
 - Suborder Spirurina Railliet & Henry, 1915
 - Superfamily Anguilliculoidea Yamaguti, 1935 [*incerta sedis*]
 - Family Anguillicolidae Yamaguti, 1935
 - Superfamily Dracunculoidea Stiles, 1907 [*incerta sedis*]
 - Family Philometridae Baylis & Daubney, 1926
 - Family Guyanemidae Petter, 1975
 - Family Daniconematidae Moravec & Køie, 1987
 - Infraorder Gnathostomatomorpha De Ley & Blaxter, 2002
 - Superfamily Gnathostomatoidea Railliet, 1895
 - Family Gnathostomatidae Railliet, 1895
 - Infraorder Oxyuridomorpha De Ley & Blaxter, 2002
 - Superfamily Oxyuroidea Cobbold, 1864
 - Family Oxyuridae Cobbold, 1864
 - Infraorder Spiruromorpha De Ley & Blaxter, 2002
 - Superfamily Camallanoidea Railliet & Henry, 1915
 - Family Camallanidae Railliet & Henry, 1915
 - Superfamily Thelazioidea Skryabin, 1915
 - Family Rhabdochonidae Travassos, Artigas & Pereira, 1928
 - Superfamily Spiruroidea Orley, 1885
 - Family Spiruridae Orley, 1885
 - Superfamily Habronematoidea Chitwood & Wehr, 1932
 - Family Hedruridae Railliet, 1916
 - Family Tetrameridae Travassos, 1914
 - Family Cystidicolidae Skryabin, 1946
 - Superfamily Acuarioidea Railliet, Henry & Sisoff, 1912
 - Family Acuariidae Railliet, Henry & Sisoff, 1912
 - Infraorder Ascaridomorpha De Ley & Blaxter, 2002
 - Superfamily Ascaridoidea Baird, 1853
 - Family Raphidascarididae Hartwich, 1954*
 - Family Anisakidae Railliet & Henry, 1912
 - Family Acanthocheilidae Wülker, 1929
 - Superfamily Seuratoidea Hall, 1916
 - Family Cucullanidae Cobbold, 1864
 - Family Quimperiidae Gendre, 1928
 - Superfamily Metastrongyloidea Cram, 1927
 - Family Pseudaliidae Railliet, 1916

*but see page 7 above

Phylum NEMATODA Potts, 1932: diagnosis

Known commonly as nematodes, eelworms, threadworms or roundworms, members of the Phylum Nematoda are probably the most abundant multicellular animals on earth. Free-living species occur in terrestrial, fresh-water,

brackish or marine environments. Parasitic species (facultative or obligate) live in association with plants, or with invertebrate and vertebrate animals, including humans. Life cycles of nematodes parasitic in animals or humans may be direct or involve two or more hosts. Usually unsegmented, round or ovoid in cross section, and tapered at both ends, nematodes range from less than one millimetre to over eight metres long. Female adults are usually larger than male adults. The anterior end is radially symmetrical but most organs are bilaterally symmetrical. A non-cellular cuticle, secreted by syncytial hypodermis, is shed four times during ontogeny. The hypodermis usually has four cords (chords): one dorsal, one ventral, and two lateral. Body-wall musculature one layer thick, longitudinal only. Pseudocoelom derived from embryonic blastocoel. Various external sensillae and ornamentations, including papillae, setae, amphids, phasmids, and annulations present or absent. Ganglia are associated with a circumpharyngeal nerve ring. Usually four major longitudinal nerves are present: one ventral, one dorsal, and at least one pair lateral. Mouth anterior, the anus at or near the posterior end. In some parasitic nematodes the pharynx is transformed into a glandular organ (stichosome), or mid-gut into a reserve organ (trophosome). In some nematodes the oesophagus is divided into an anterior muscular portion and a posterior glandular portion. The excretory-secretory system is glandular or tubular, a ventral pore opening near the anterior end [this system is referred to as the excretory system/pore/duct/cell throughout the rest of this part of the Guide]. Most nematodes are dioecious, some hermaphroditic or parthenogenetic. Most are oviparous, some ovoviviparous. Females usually have two ovaries, though there may be from one to six or more, and the female pore opens ventrally. The male system, usually with two testes, opens with anus into cloaca. Male tail curved or broadened into a fan-shaped bursa usually with one or two chitinized spicules; spicules sometimes absent. During copulation spicule or spicules enter the female pore, and amoeboid sperm are transferred.

KEYS to NEMATODA

The following keys are designed to aid identification of larval and/or adult nematodes recovered from Canadian fishes from any aquatic environment, be it fresh water, brackish water or marine. The keys may be unsuitable for identifying material from other areas.

A single asterisk (*) preceding a nematode's scientific name denotes that the taxon has been recorded only in its larval stage in given fish host(s), a double asterisk (**) denotes records of both larvae and adults in given host(s), whilst an unadorned taxon denotes records of only adults in given host(s).

Key to Classes of NEMATODA

- 1 Phasmids absent; amphids pocket-like; caudal papillae absent or few in number; oesophagus cylindrical or with oesophageal glands free in the pseudocoelom forming a stichosome; excretory system without lateral canals, terminal duct not lined with cuticle Enoplea
- Phasmids present; amphids pore-like; caudal papillae usually numerous (basic number 21); oesophagus never in the form of a stichosome; excretory system with lateral canals, terminal duct lined with cuticle Chromadorea

Key to Orders of the Class ENOPLEA and Subclass DORYLAIMIA

- 1 Oesophagus cylindrical and well developed; stichosome or trophosome absent; monodelphic. Dioctophymatida Baylis & Daubney, 1926
- Stichosome or trophosome present; intestine and rectum well developed; sexes separate; monodelphic Trichinellida Hall, 1916

Comments. dioctophymatid nematodes that occur in Canadian fishes are larval stages representing the Suborder Dioctophymatina Skryabin, 1927 (Family Dioctophymatidae Castellani & Chalmers, 1910). A key to the genera of this Family is given below.

Key to genera of larvae in the Family DIOCTOPHYMATIDAE

- 1 L3 encapsulated in fish hosts, mostly in hypaxial musculature; six inner labial papillae single and button-like, with central pore-like depression; outer six labial papillae twice as large as the inner, four of them single and two double. Male L3: mean 5.9 (range 4.1–7.4) long; width at oesophago-intestinal junction 0.15 (0.11–0.19). Female L3: 6.5 (5.1–8.6) long; width at oesophago-intestinal junction 0.18 (0.16–0.20); vulva just behind oesophago-intestinal valve. Intestinal region of live L3 red in colour. **Diectophyme*
- L3 and L4 encapsulated in fish hosts, on mesenteries; six inner labial papillae single with narrow bases and spike-like apices; four of six outer labial papillae single, two of them double, with broad bases and nipple-like apices. Outer labial papillae double. Male L3: 21.3 (12.0–29.7) long; width at oesophago-intestinal junction 0.22 (0.14–0.30). Female L3: 21.5 (11.5–34.8) long; width at oesophago-intestinal junction 0.21 (0.10–0.30). Male L4: 55.1 (32.2–66.0) long; width at oesophago-intestinal junction 0.35 (0.29–0.40). Female L4: 69.5 (45.1–83.4) long; width at oesophago-intestinal junction 0.42 (0.37–0.46); vulva just behind intestine-rectal junction. Live L3 white or pink in colour, live L4 bright red in colour. **Eustrongylides*

**Diectophyme* Collet-Meygret, 1802

Generic diagnosis (after Mace & Anderson 1975, and Measures & Anderson 1985). Diectophymatidae. Encapsulated L3 occur most commonly in hypaxial musculature of fishes, some in body cavity. Two circles of labial papillae surround mouth. Inner circle comprises six single papillae. Outer circle comprises four single and two double papillae. Amphids situated laterally between the interno- and externo-lateral papillae (Fig. 15A). Three large cells (one dorsal, two subventral) surround narrow buccal capsule and anterior end of oesophagus (Fig. 15B). Average length of oesophagus about 40% of total body length. A large circular muscle constitutes the oesophago-intestinal sphincter (Fig. 15C). For length and width of male L3 from pumpkinseed *Lepomis gibbosus* see key above. Genital primordium diorchic and opisthorchic. For length and width of female L3 from pumpkinseed see key above. Vagina evident; non-patent vulva near oesophago-intestinal valve. Genital primordium monodelphic and opisthodelphic. Anus terminal in both sexes. Cuticles of 1st and 2nd moults retained.

One species, **D. renale*, has been found as L3 in Canadian fresh-water fishes. Adult *D. renale* occur in the kidneys of piscivorous mammals, especially mustelids and wild canids.

**Diectophyme renale* (Goeze, 1782) Stiles, 1901

Sites: musculature, mesenteries, viscera

Hosts: *Ameiurus nebulosus* (1, 2); *Lepomis gibbosus* (2)

Distribution: Ontario

Records: 1. Mace & Anderson 1975; 2. Measures & Anderson 1985

**Diectophyme* sp.

Site: body cavity

Host: *Micropterus salmoides*

Distribution: Ontario

Record: Bangham & Hunter 1939

**Eustrongylides* Jägerskiöld, 1909

Generic diagnosis (after Measures 1988b). Diectophymatidae. Encapsulated L3 and L4 occur on mesenteries of fish hosts, including pumpkinseed *Lepomis gibbosus*, rock bass *Ambloplites rupestris*, and yellow perch *Perca flavescens*. L3 retain 2nd stage cuticle. Two circles of labial papillae surround mouth. Six papillae of the inner circle single with narrow bases and spike-like apices. Six papillae of outer circle have broad bases and nipple-like apices. In males the spicule primordium enters rectum dorsally (Fig. 16A); genital primordium enters ventrally, and

extends anteriorly almost to oesophago-intestinal valve where it curves posteriorly and terminates bluntly. Caudal sucker of males more developed in L4 than in L3. In females, genital primordium extends anteriorly (Fig. 16B), and curves posteriorly, with its blunt extremity ending behind intestine-rectal junction. For length and width of male and female L3 see key above. L4 retain 2nd and 3rd stage cuticles. Labial papillae of L4 similar in shape and position to those of L3 but larger and more prominent (Fig. 16C). Male and female genital primordia include thin-walled hologonic testis and ovary respectively. For length and width of male and female L4 see key above. One species, **E. tubifex*, has been found as L3 and L4 in various Canadian fresh-water fishes. Adult *E. tubifex* occur in the proventriculus of mergansers and other piscivorous birds.

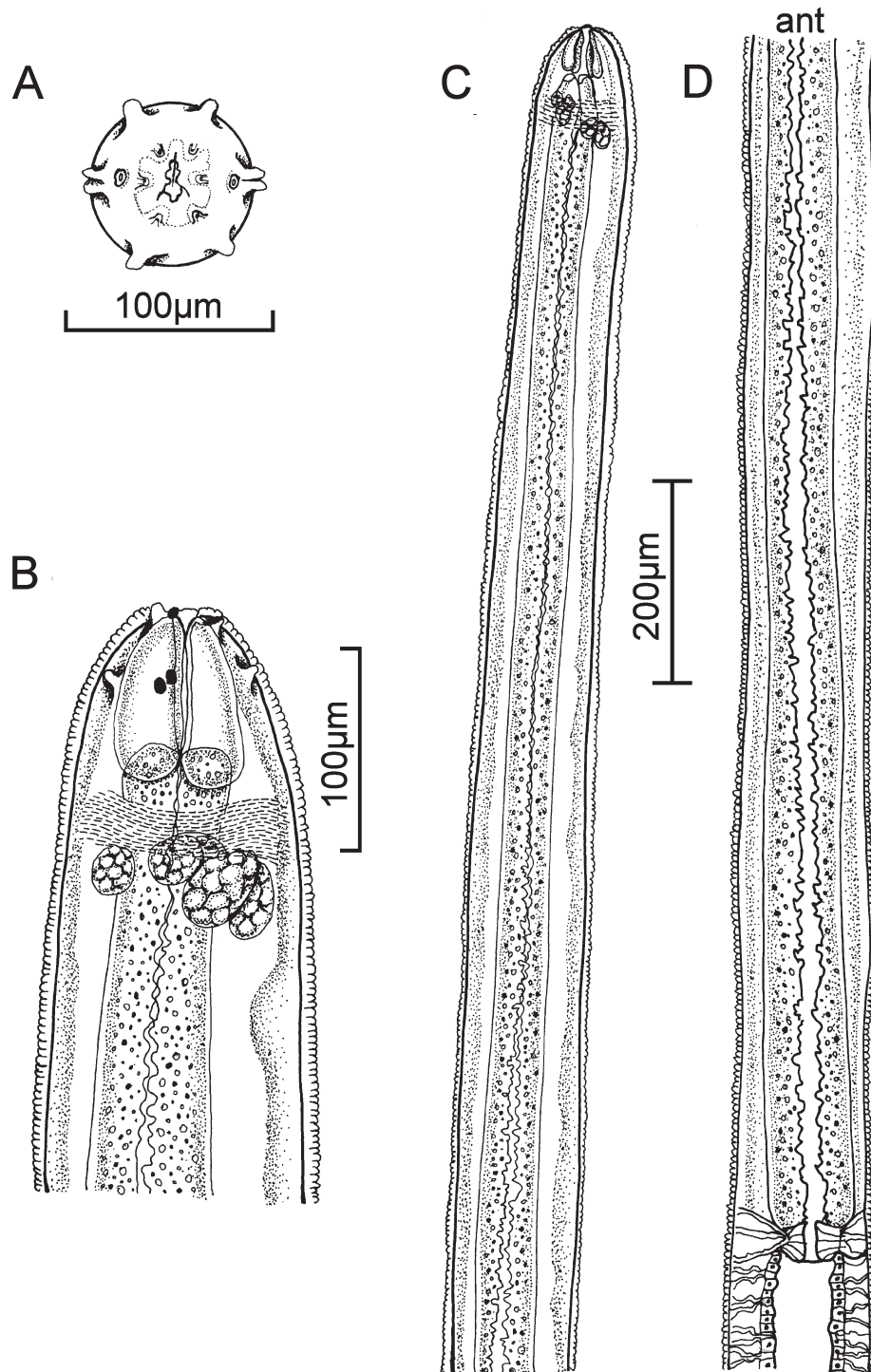


FIGURE 15. **Dioctophyme renale* (Goeze, 1782) Stiles, 1901. A. en face view of larva; B. anterior end of larva; C. and D. (contiguous) anterior third of larva. (Redrawn from Mace & Anderson 1975)

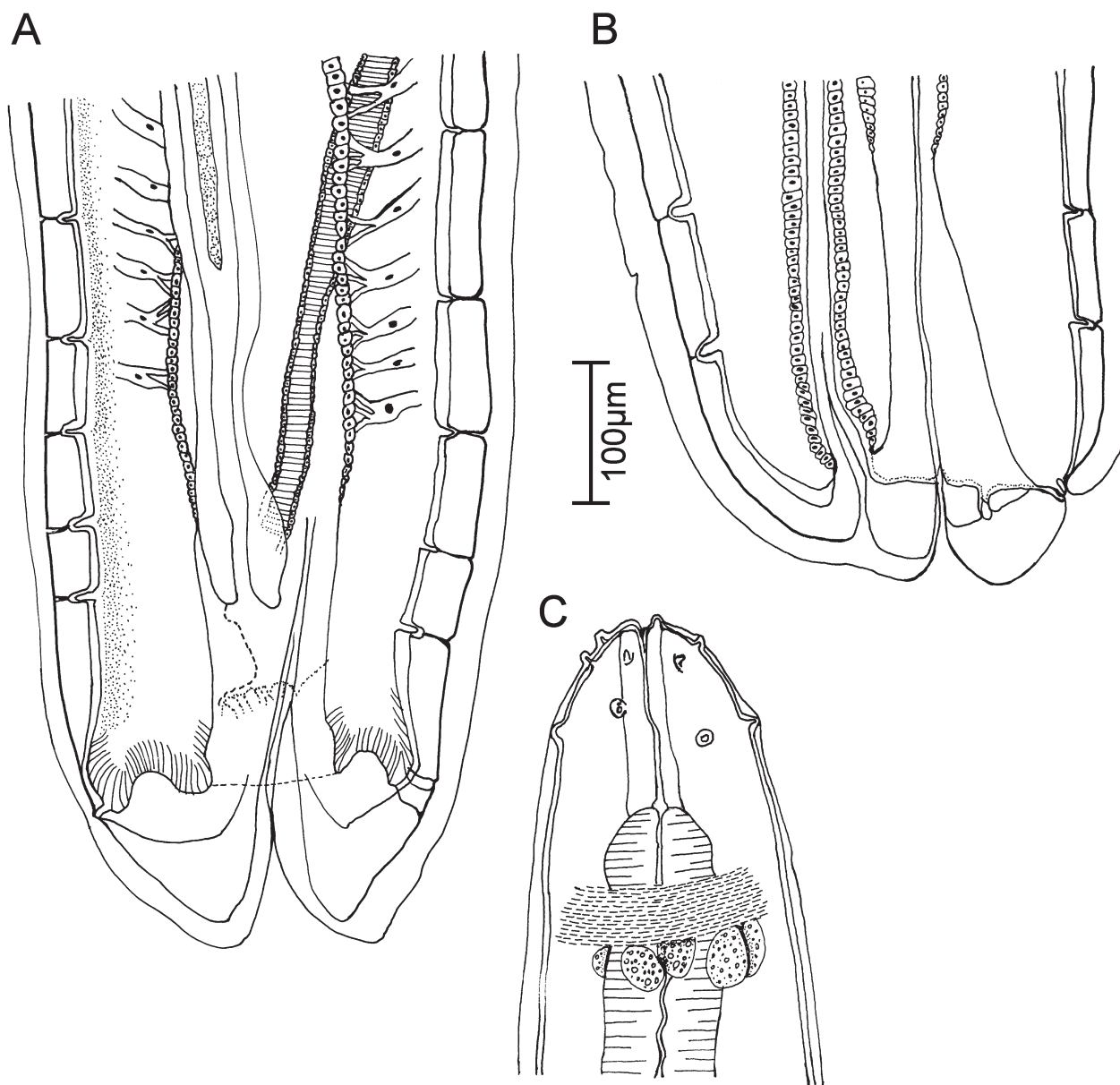


FIGURE 16. *Eustrongylides tubifex* Jägerskiöld, 1909. A. male larva, posterior end, dorsal view; B. female larva, posterior end, lateral view; C. male larva, anterior end, dorsal view. (Redrawn from Measures 1988b)

***Eustrongylides tubifex* (Nitzsch, 1819) Jägerskiöld, 1909**

Site: mesenteries

Hosts: *Ambloplites rupestris* (1, 2, 3, 4); *Ameiurus nebulosus* (4, 8); *Aplodinotus grunniens* (4, 6); *Catostomus catostomus* (8); *Catostomus commersonii* (3, 6, 8); *Culaea inconstans* (8); *Fundulus diaphanus* (5); *Ictalurus punctatus* (6); *Lepomis gibbosus* (1, 2, 3, 4, 8); *Micropterus dolomieu* (4, 5, 6); *Morone americana* (4); *Morone chrysops* (6); *Oncorhynchus mykiss* (7); *Perca flavescens* (1, 2, 3, 4, 5, 6, 8); *Sander vitreus* (4); unspecified “fish” (7)

Distribution: Ontario

Records: 1. Measures 1987 (ON); 2. Measures 1988a (ON); 3. Measures 1988b (ON); 4. Dechtiar & Christie 1988 (ON) ; 5. Dechtiar *et al.* 1988 (ON); 6. Dechtiar & Nepszy 1988 (ON); 7. Measures 1988c (EX, ON); 8. Dechtiar *et al.* 1989 (ON)

****Eustrongylides* sp.**

Sites: body cavity, musculature, ovaries, viscera

Hosts: *Catostomus commersonii* (1, 2, 3, 21); *Catostomus macrocheilus* (3); *Cottus asper* (3, 15); *Cottus cognatus* (12, 14); *Gasterosteus aculeatus* (3, 7, 9, 22); *Entosphenus tridentatus* (3); *Lepomis gibbosus* (11); *Lota lota* (12, 13, 14, 15); *Mylocheilus caurinus* (3, 14); *Oncorhynchus clarkii* (3, 10); *Oncorhynchus kisutch* (4); *Oncorhynchus mykiss* (10, 12, 14, 15); *Perca flavescens* (5, 6, 8); *Prosopium cylindraceum* (3); *Prosopium williamsoni* (3, 12, 13, 14, 15, 20); *Ptychocheilus oregonensis* (12, 13, 14, 15); *Salvelinus fontinalis* (16, 17, 18, 19); *Salvelinus malma* (3, 12, 14); *Salvelinus namaycush* (3, 15); *Sander canadensis* (5, 6); *Sander vitreus* (6)

Distribution: British Columbia, New Brunswick, Ontario, Quebec

Records: 1. Bangham 1941 (ON); 2. Bangham & Venard 1946 (ON); 3. Bangham & Adams 1954 (ON); 4. Godfrey 1968 (BC); 5. Dechtiar 1972a (ON); 6. Dechtiar 1972b (ON); 7. Hanek & Molnar 1974 (QC); 8. Molnar *et al.* 1974 (ON); 9. Lester 1974 (BC); 10. Hoskins *et al.* 1976 (BC); 11. Cone & Anderson 1977 (ON); 12. Anon. 1978 (ON); 13. Anon. 1981 (BC); 14. Arai & Mudry 1983 (BC); 15. Anon. 1984 (BC); 16. Frimeth 1986 (BC); 17. Frimeth 1987a (NB); 18. Frimeth 1987b (NB); 19. Marcogliese & Cone 1991a (NB); 20. Nener *et al.* 1995 (BC); 21. Couillard *et al.* 1995 (QC); 22. Reimchen 1997 (BC)

Key to Families of the Order TRICHINELLIDA

- | | | |
|---|--|------------------|
| 1 | Digestive tract complete; anus present; vulva near end of oesophagus | 2 |
| - | Digestive tract incomplete; anus absent; intestine dilated into sac or modified to form trophosome; vulva near nerve ring .. | 3 |
| 2 | Spicule and spicular sheath present; stichocytes regularly aligned throughout length of oesophagus | Capillariidae |
| - | Spicule and spicular sheath absent or vestigial; stichocytes irregularly aligned in posterior region of oesophagus | Trichosomoididae |
| 3 | Female body divided into thin, anterior region and posterior globular region; stichocytes unicellular; spicule present, spicular sheath poorly developed | Cystoosidae |

Family CYSTOOPSIDAE Skryabin, 1923

Family diagnosis (after Moravec 2001). Cystoosidae. Anus atrophied. Adults with pronounced sexual dimorphism. Male body cylindrical. Body of female divided into thread-like anterior region and globular posterior region. Anterior part of body bears transverse rings of numerous minute cuticular tubercles. Oesophagus divided into short anterior muscular portion and long posterior glandular portion.

One genus, *Cystoopsis* Wagner, 1867, is known from one fish species in Canada. The genus is represented by one species, *C. acipenseris*.

***Cystoopsis acipenseris* Wagner, 1867**

Description (after Moravec 2001). Head rounded in both sexes. Mouth opening triangular, surrounded by ring mound with 10 small teeth. Four small cephalic papillae, and pair of lateral amphids. Anterior muscular portion of oesophagus well developed, posterior glandular portion comprising two longitudinal rows of stichocytes (Fig. 17A). Intestine in both sexes ends blindly.

Males: body cylindrical, both ends rounded, 2.10–3.00 long, 0.017–0.024 wide. Cuticle with fine cuticular tubercles. Muscular oesophagus 0.27–0.28 long, glandular one 0.70–0.73 long. Nerve ring encircles muscular oesophagus slightly behind its proximal end. Testis convoluted, filling entire body-cavity. Spicule fine, moderately sclerotized, 0.23–0.26 long. Spicular sheath present (Fig. 17B).

Females: anterior body region thread-like 2.48–2.74 long, posterior globular region 5.0–6.0 in diameter (Fig. 17C). Anterior cuticle with transverse rings of minute tubercles. Muscular oesophagus 0.54–0.57 long, glandular one 1.09–1.18 long. Oesophago-intestinal junction in anterior body region. Intestine continues into posterior globular region ending blindly as a sac 2.0–2.5 wide. Nerve ring 0.48–0.52 from anterior end. Vulva 0.080–0.120 from anterior end (Fig. 17A). Muscular vagina passes through thread-like body region. Uterine coils, ovary and

oesophagus fill body-cavity in posterior body region. Uterus contains many eggs at different stages of development, mature ones containing formed larvae. Mature eggs thin-walled with smooth surface, barrel-shaped with polar plugs, 0.063–0.068 x 0.021–0.025 (Fig. 17D).

Site: subcutaneous

Host: *Acipenser transmontanus* (1, 2)

Distribution: British Columbia

Records: 1. Margolis & McDonald 1986; 2. McDonald *et al.* 1989

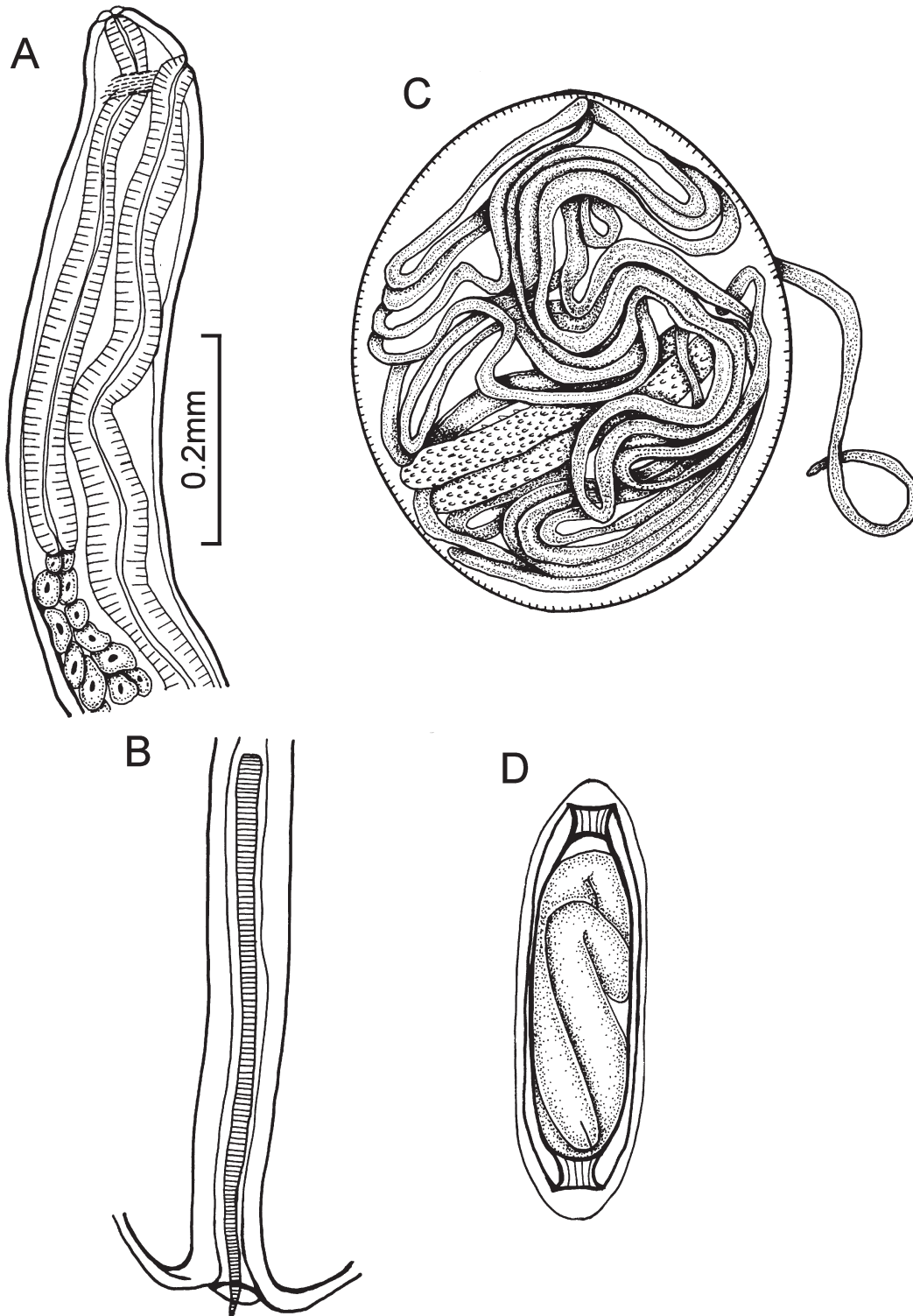


FIGURE 17. *Cystoopsis acipenseris* Wagner, 1867. A. female, anterior end; B. spicule; C. entire female; D. egg. NB: scale bars were not provided in the original for B., C. or D. (Redrawn from Moravec 2001)

Family CAPILLARIIDAE Railliet, 1915

General characteristics (after Moravec 2001). Thread-like nematodes. Cuticle with longitudinal bacillary bands, usually two lateral, one dorsal and one ventral. One sclerotized spicule with smooth or spiny spicular sheath, able to invaginate or evaginate. Posterior end of male with or without small membranous bursa. Vulva near posterior end of oesophagus, sometimes with elevated lips. Eggs usually barrel-shaped with polar plugs, and a smooth or sculptured surface.

Key to genera of CAPILLARIIDAE

- | | | |
|---|--|-------------------------|
| 1 | Spicular sheath covered with small spines | 2 |
| - | Spicular sheath non-spiny | 3 |
| 2 | Male tail lacks membranous bursa; either two large caudal ventro-lateral lobes each with a papilla at the base, or lobes absent with only one pair of papillae; eggs with short polar plugs either not or only slightly protruding from egg shell. | <i>Capillaria</i> |
| - | Male tail with membranous bursa supported by two lateral finger-shaped processes (rays) and one pair of papillae at their base; unpaired dorsal caudal projection present; polar plugs slightly protruding from egg shell | <i>Piscicapillaria</i> |
| 3 | Male tail with membranous bursa supported by two narrow digital projections (rays) adhering to rounded body end | <i>Paracapillaria</i> |
| - | Male tail without membranous bursa but with two large, spherical ventro-lateral lobes bearing a pair of small indistinct papillae | <i>Pseudocapillaria</i> |

Comments: Moravec (2001) recognized 13 subgenera—four of *Capillaria*, two of *Piscicapillaria*, three of *Paracapillaria*, and four of *Pseudocapillaria*. Two of the subgenera of *Capillaria*, one each of *Piscicapillaria* and *Paracapillaria*, and two of *Pseudocapillaria* are represented in Canadian fishes. Whilst the subgenera are given below, they do not need to be defined as the various species key out satisfactorily.

Capillaria Zeder, 1800

Generic diagnosis (after Moravec 2001). Capillariidae. Stichosome comprises one row of stichocytes. Lateral caudal alae absent from males. Posterior end of male rounded, usually with two lateral or ventro-lateral lobes. Membranous bursa absent. One pair of small papillae near cloacal opening. Spicule with many rough transverse grooves on surface. Spicular sheath spiny.

Key to species of *Capillaria*

- | | | |
|---|---|---|
| 1 | Male tail with large ventro-lateral lobes, and large paired caudal papillae; gravid worms with vulvar appendage; parasitic in marine fishes | 2 |
| - | Ventro-lateral lobes on male tail indistinct, and large paired caudal papillae; vulvar appendage absent; parasitic in fresh-water fishes | 3 |
| 2 | Spicule relatively short, <i>ca</i> 0.2 long. Pacific Ocean | <i>Capillaria</i> (<i>Procapillaria</i>) <i>margolisi</i> |
| - | Spicule relatively long, <i>ca</i> 1.0–1.4 in length. Atlantic Ocean. | <i>Capillaria</i> (<i>Procapillaria</i>) <i>gracilis</i> |
| 3 | Evaginated spicular sheath spiny proximally only; mature eggs with non-protruding polar plugs | <i>Capillaria</i> (<i>Capillaroides</i>) <i>catenata</i> |

Capillaria (*Procapillaria*) *margolisi* Moravec & McDonald, 1981

Description (after Moravec 2001). With characteristics of the genus.

Males: Body length 13.57, maximum width 0.074. Muscular oesophagus 0.359 long, stichosome 8.94, 58 stichocytes. Nerve ring 0.161 from anterior end (Fig. 18A). Spicule well sclerotized with rough transverse grooves on middle third, 0.202 long (Fig. 18B). Cloaca opening subterminal. Tail rounded, 0.009 long, with a 0.023 long lobe on either side probably with submerged papillae (Fig. 18C). Pair of small sessile papillae just anterior to cloacal opening.

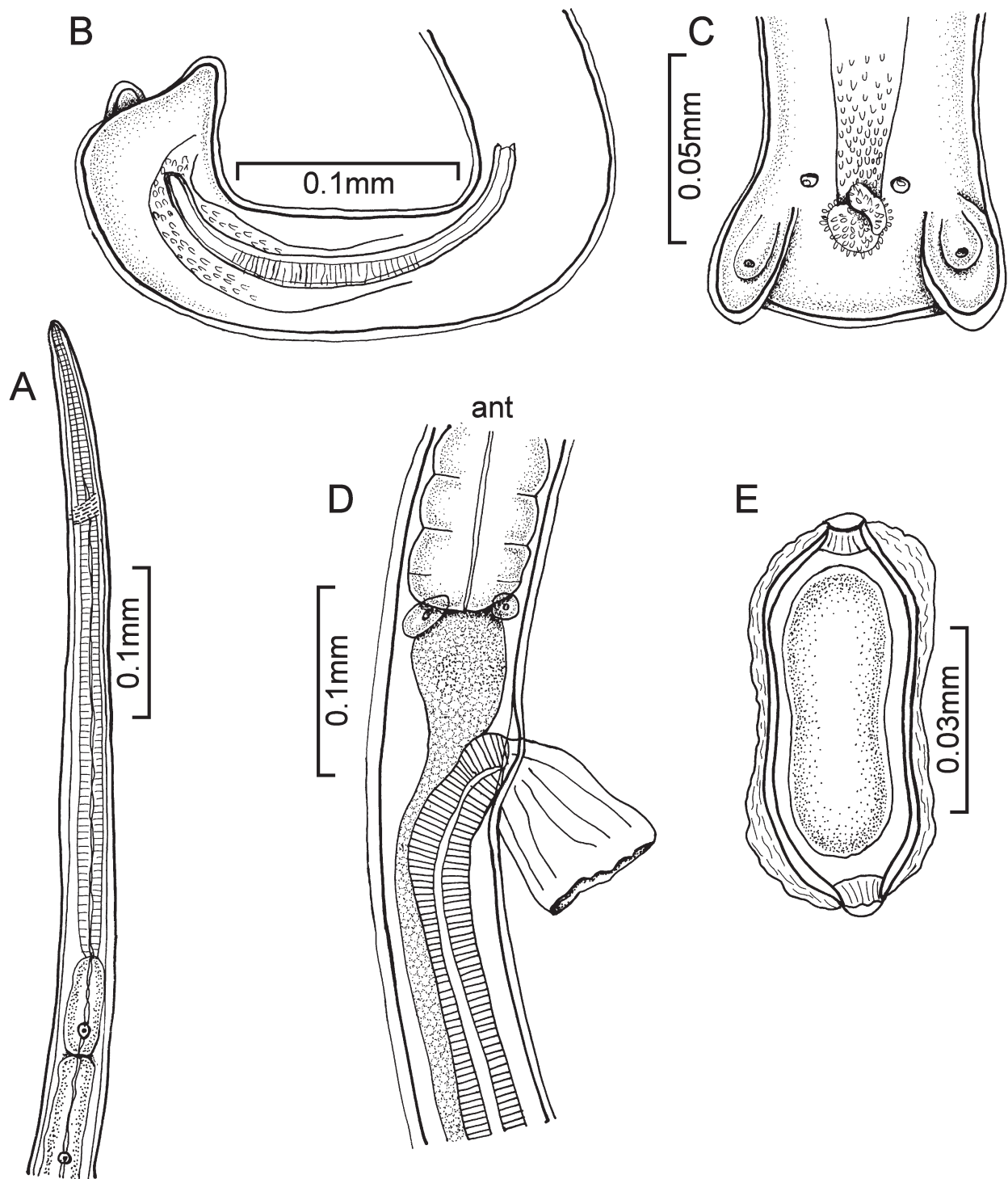


FIGURE 18. *Capillaria (Procapillaria) margolisi* Moravec & McDonald, 1981. A. anterior end; B. male, posterior end, lateral view; C. male, tail, ventral view; D. vulvar region; E. mature egg. (Redrawn from Moravec 2001)

Females: Gravid worms 18.58–21.76 long, maximum width 0.093–0.112. Muscular oesophagus 0.359–0.382 long, stichosome 8.73–9.92, 44 to 51 stichocytes. Nerve ring 0.115–0.129 from anterior end. Vulva near level of oesophago-intestinal junction (Fig. 18D). Uterus with many eggs in one row near vulva, two or more rows distally. Mature eggs 0.062–0.069 x 0.025–0.028 (Fig. 18E). Ovary reaching posteriad to about mid-region of rectum. Rectum 0.081–0.110 long. Anus subterminal, tail 0.012–0.021 long.

Site: pyloric caeca

Hosts: *Hippoglossus stenolepis* (2, 3, 4); *Scorpaenichthys marmoratus* (1)

Distribution: Pacific

Records: 1. Moravec & McDonald 1981; 2. Blaycock 1996; 3. Blaycock *et al.* 1998a; 4. Blaycock *et al.* 1998b

***Capillaria (Procapillaria) gracilis* (Bellingham, 1840) Travassos, 1915**

Synonym: *Capillaria kabatai* Inglis & Coles, 1963

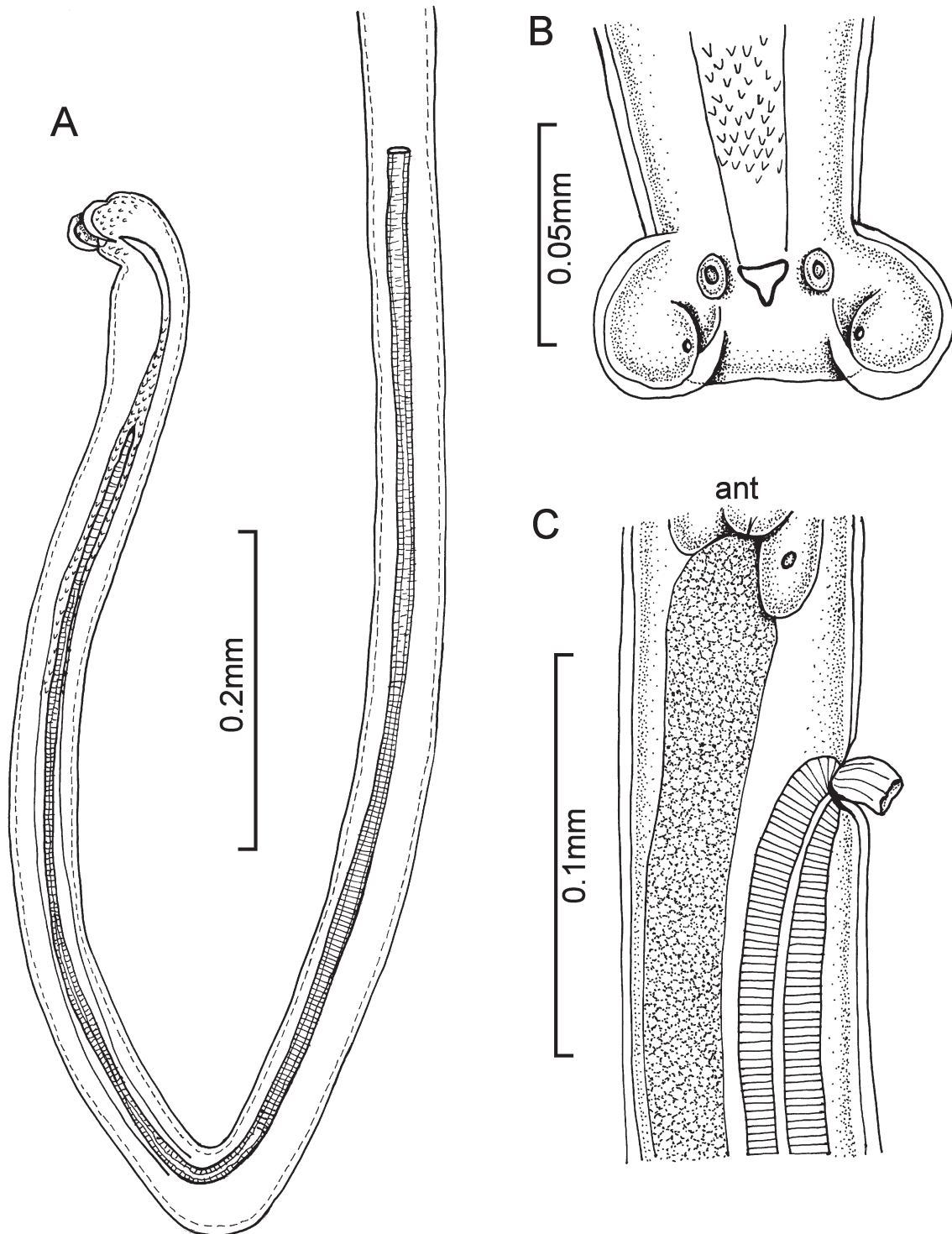


FIGURE 19. *Capillaria (Procapillaria) gracilis* (Bellingham, 1840) Travassos, 1915. A. male, posterior end; B. male, tail, ventral view; C. female, vulvar region with appendage. (Redrawn from Moravec 2001)

Description (after Moravec 2001). With characteristics of the genus.

Males: Body length 7.14–8.42 long, maximum width 0.041–0.054. Muscular oesophagus 0.180–0.396 long, stichosome 4.04–6.85, 47 stichocytes. Nerve ring 0.111 from anterior end. Spicule slender, 0.975–1.375 long, posterior half with rough transverse grooves (Fig. 19A). Cloaca opening subterminal. Tail rounded, 0.009–0.018 long, with ventro-lateral lobe, 0.018–0.027 long, on either side, each probably with a papilla (Fig. 19B). Pair of large sessile adcloacal papillae at lobe bases.

Females: Gravid worms 13.20–35.16 long, maximum width 0.068–0.095. Muscular oesophagus 0.225–0.450 long, stichosome 5.04–8.73, 38–51 stichocytes. Nerve ring 0.081–0.114 from anterior end. Vulva with appendage 0.027–0.123 behind oesophago-intestinal junction (Fig. 19C); rarely gravid females lack the appendage. Uterus with many eggs in one row near vulva. Mature eggs 0.072–0.090 x 0.027–0.036.

Site: intestine

Hosts: *Anarhichas lupus* (2); *Hippoglossoides platessoides* (2); *Hippoglossus hippoglossus* (2); *Macrourus berglax* (3); *Merluccius albidus* (4); *Merluccius bilinearis* (1); *Myoxocephalus octodecemspinosus* (5); *Nezumia bairdii* (3); *Urophycis chuss* (4); *Urophycis tenuis* (4)

Distribution: Atlantic

Records: 1. Gaevskaya & Umnova 1977; 2. Zubchenko 1980; 3. Zubchenko 1981a; 4. Scott 1987; 5. Moravec 1987

***Capillaria (Capillaroides) catenata* Van Cleave & Mueller, 1932**

Synonym: *Capillaria (Thominx) catenata* Van Cleave & Mueller, 1932

Description (after Moravec 2001). With characteristics of the genus.

Males: 7.70–9.04 long, 0.068 maximum width. Entire oesophagus 5.90–6.48 long, 40 stichocytes. Spicule apparently weakly sclerotized, 0.399–0.465 long, covered with transverse grooves except at extremities (Fig. 20A). Posterior end rounded, somewhat inflated both sides, with two large ventro-lateral papillae. Cloacal opening subterminal, tail 0.018 long.

Females: Gravid worms 10.98–12.27 long, maximum width 0.068–0.095. Muscular oesophagus 0.210–0.300 long, stichosome 5.60–6.29 long, 40–44 stichocytes. Nerve ring 0.063–0.096 from anterior end. Vulva 0.009–0.090 behind oesophago-intestinal junction, its lips not elevated. Vulvar appendage absent (Fig. 20B). Relatively few eggs (*ca* 10) in uterus, in one row. Eggs 0.057–0.060 x 0.030–0.039 (possibly expanded by coverslip pressure).

Site: intestine

Hosts: *Ambloplites rupestris* (2); *Catostomus commersoni* (1); *Oncorhynchus nerka* (3, 4); *Osmerus mordax* (3, 4)

Distribution: Ontario, Quebec

Records: 1. Fantham & Porter 1948 (QC); 2. Dechtiar 1972a (ON); 3. Collins & Dechtiar 1974 (ON); 4. Dechtiar *et al.* 1988 (ON)

***Capillaria* sp.**

Sites: intestine, stomach

Hosts: *Ameiurus nebulosus* (1); *Anoplopoma fimbria* (11); *Apodichthys flavidus* (5); *Artedius harringtoni* (4); *Chitonotus pugetensis* (5); *Cryptacanthodes giganteus* (3); *Gadus morhua* (7, 10); *Hemilepidotus hemilepidotus* (4); *Hexagrammos lagocephalus* (4); *Lycodes brevipes* (5); *Malacocottus kincaidi* (5); *Melanogrammus aeglefinus* (8, 9); *Micropterus dolomieu* (1); *Myoxocephalus polyacanthocephalus* (4); *Oncorhynchus kisutch* (4, 5); *Oncorhynchus tshawytscha* (5); *Paraplagusia bilineata* (2, 4, 5); *Parophrys vetulus* (2, 3); *Sebastes alutus* (6); *Sebastes babcocki* (6); *Sebastes borealis* (6); *Sebastes caurinus* (6); *Sebastes flavidus* (6); *Sebastes maliger* (6); *Sebastes nigrocinctus* (6); *Sebastes paucispinis* (6); *Sebastes ruberrimus* (2, 6)

Distribution: Atlantic, Ontario, Pacific

Records: 1. Bangham 1941 (ON); 2. Margolis 1952a (PA); 3. Margolis 1952b (PA); 4. Arai 1967a (PA); 5. Arai 1969 (PA); 6. Sekerak & Arai 1977 (PA); 7. Appy 1981 (AT); 8. Scott 1981 (AT); 9. Scott 1982 (AT); 10. Appy & Burt 1982 (AT); 11. Kabata & Whitaker 1984 (PA)

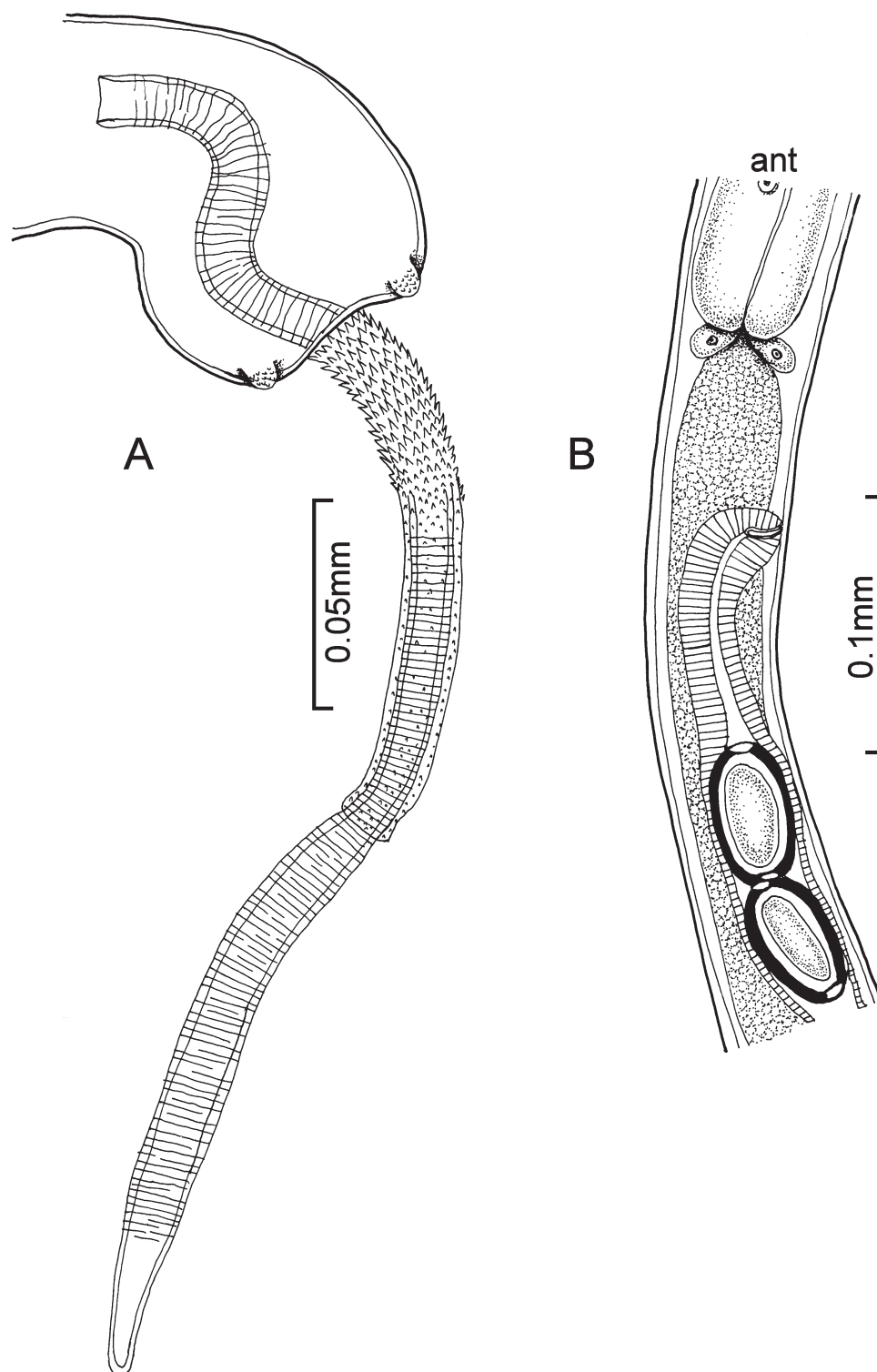


FIGURE 20. *Capillaria (Capillaroides) catenata* Van Cleave & Mueller, 1932. A. male, posterior end with evaginated spicular sheath and protruding spicules; B. female, vulvar region. (Redrawn from Moravec 2001)

Capillariidae gen. sp.

Site: alimentary tract

Hosts: *Mylocheilus caurinus* ; *Oncorhynchus mykiss*; *Ptychocheilus oregonensis*

Distribution: British Columbia

Record: 1. Anon. 1984

***Piscicapillaria* Moravec 1982**

Generic diagnosis (after Moravec 2001). Capillariidae. Stichosome comprises one row of stichocytes. Males lack lateral caudal alae. Spicular sheath spiny. Small membranous bursa supported by pair of dorso-lateral digital projections (rays), curved along margin of bursa to dorsal side, and an unpaired dorsal caudal projection. One pair large caudal papillae present. Vulvar appendage absent.

One species, *Piscicapillaria* (*Piscicapillaria*) *freemani*, known from Canadian Pacific fishes.

***Piscicapillaria* (*Piscicapillaria*) *freemani* (Moravec, Margolis & McDonald, 1981) Moravec, 1982**

Synonym: *Capillaria freemani* Moravec, Margolis & McDonald, 1981

Description (after Moravec 2001). With characteristics of the genus.

Males: Body length 13.35–25.76 long, maximum width 0.047–0.074. Muscular oesophagus 0.338–0.414 long, stichosome 6.09–11.35, 46–50 stichocytes. Nerve ring 0.081–0.092 from anterior end. Spicule 0.653–0.984 long, irregular transverse grooves on the third quarter of its length (Fig. 21A). Tail rounded. Wide membranous bursa supported by dorsal caudal projection and by a wide ray on each side, at the base of which is a large spherical papilla. Bursa 0.012–0.028 long (Fig. 21B).

Females: Vulva 0.041–0.108 below oesophago-intestinal junction, lips either not elevated or anterior one only slightly so (Fig. 21C). Mature eggs 0.078–0.090 x 0.028–0.035, polar plugs slightly protruding (Fig. 21D). Posterior end of ovary not reaching rectum, which is 0.083–0.150 long. Anus terminal.

Site: spiral valve

Hosts: *Bathyrhaja interrupta*; *Raja rhina*; *Raja stellulata*

Distribution: Pacific

Record: Moravec *et al.* 1981

***Paracapillaria* Mendonça, 1963**

Generic diagnosis (after Moravec 2001). Capillariidae. Stichosome comprises one row of stichocytes. Males lack lateral caudal alae. Membranous bursa supported by two lateral digital processes (rays) bent along posterior border of bursa to dorsal side (Fig. 22A). Dorsal caudal projection absent. Pair of large sessile ad-cloacal or post-cloacal papillae present. Spicule without rough transverse grooves on surface. Spicular sheath non-spiny. Vulvar appendage absent.

One species, *Paracapillaria* (*Paracapillaria*) *parophrysi*, known from Canadian Pacific fishes.

***Paracapillaria* (*Paracapillaria*) *parophrysi* (Moravec, Margolis & McDonald, 1981) Moravec, 1982**

Synonym: *Capillaria parophrysi* Moravec, Margolis & McDonald, 1981

Description (after Moravec 2001). With characteristics of the genus.

Males: Body length 3.98–5.74, maximum width 0.051–0.069. Muscular oesophagus 0.147–0.255 long, stichosome 1.86–2.22, 30–35 stichocytes. Nerve ring 0.060–0.078 from anterior end. Spicule well sclerotized, smooth, 0.281–0.373 long (Fig. 22B). Tail rounded, 0.009–0.014 long.

Females: Gravid worms 6.58–10.42 long, maximum width 0.056–0.093. Muscular oesophagus 0.138–0.235 long, stichosome 1.96–3.07, 33–35 stichocytes. Nerve ring 0.058–0.081 from anterior end. Vulva at level of oesophago-intestinal junction. Uterus with eggs in one row near vulva (Fig. 22C), distally in two rows. Mature

eggs 0.064–0.071 x 0.025–0.030, polar plugs distinctly protruding (Fig. 22D). Ovary posteriorly reaching anterior end of rectum. Rectum 0.081–0.113 long. Anus subterminal, tail 0.007–0.009 long.

Site: intestine

Hosts: *Hippoglossus stenolepis* (3, 4, 5); *Parophrys vetulus* (1, 2)

Distribution: Pacific

Records: 1. Margolis 1952; 2. Moravec *et al.* 1981; 3. Blaycock 1996; 4. Blaycock *et al.* 1998a; 5. Blaycock *et al.* 1998b

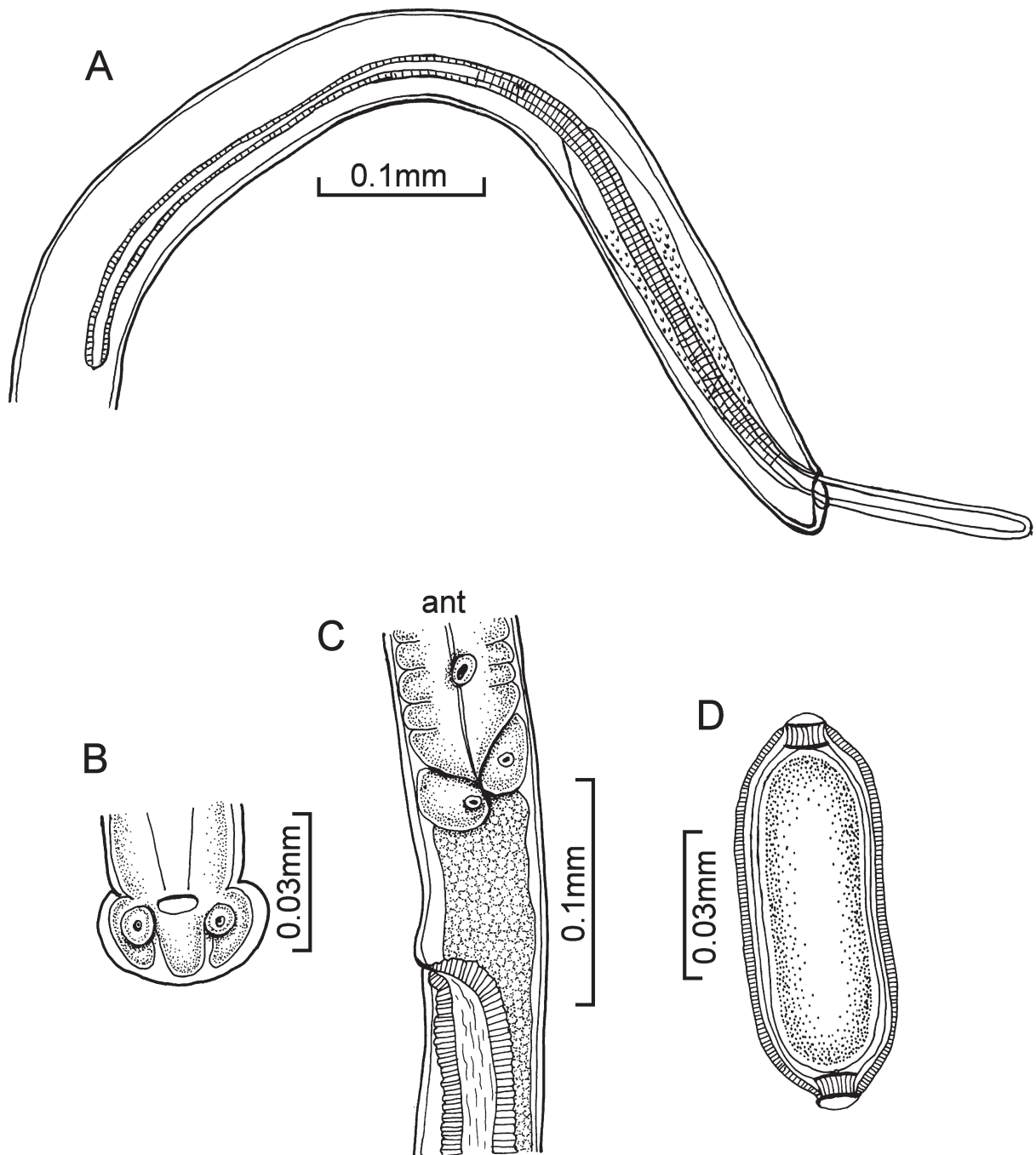


FIGURE 21. *Piscicapillaria* (*Piscicapillaria*) *freemani* (Moravec, Margolis & McDonald, 1981) Moravec, 1982. A. male, posterior end; B. male, tail, ventral view; C. female, vulvar region; D. egg. (Redrawn from Moravec 2001)

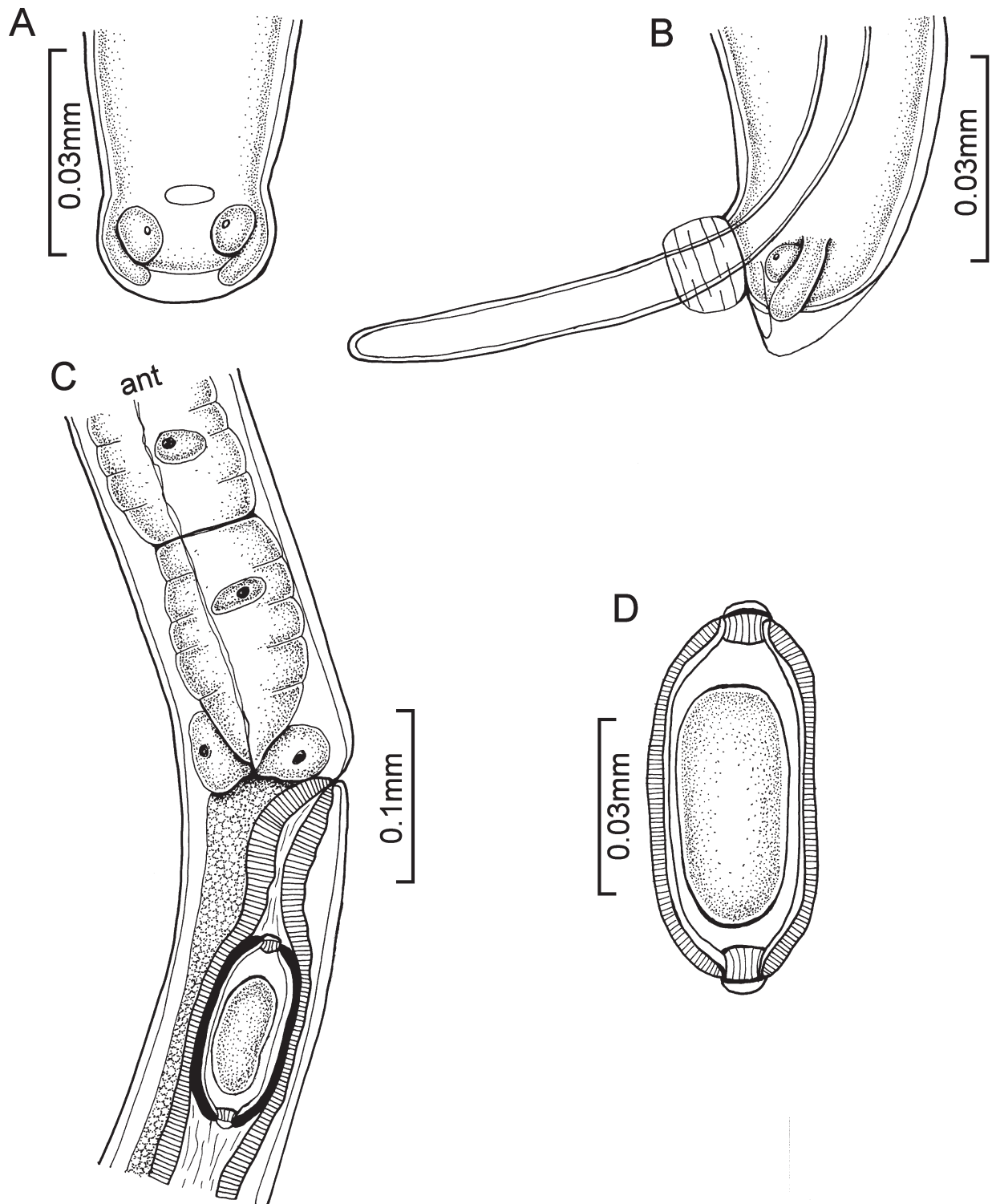


FIGURE 22. *Paracapillaria (Paracapillaria) parophrysi* (Moravec, Margolis & McDonald, 1981) Moravec, 1982. A. male, tail, ventral view; B. male, tail, lateral view; C. female, vulvar region; D. egg. (Redrawn from Moravec 2001)

***Pseudocapillaria* Freitas, 1959**

Generic diagnosis (after Moravec 2001). Capillariidae. Two lateral bacillary bands extending most of body length (Fig. 23A). Stichosome comprises one row of stichocytes. Males lack lateral caudal alae. Male tail rounded with two large spherical subventral lobes behind cloacal opening. Dorsal cuticular membrane (bursa) reduced or absent. Spicular surface lacks rough transverse grooves. Spicular sheath non-spiny. Vulvar appendage present or absent.

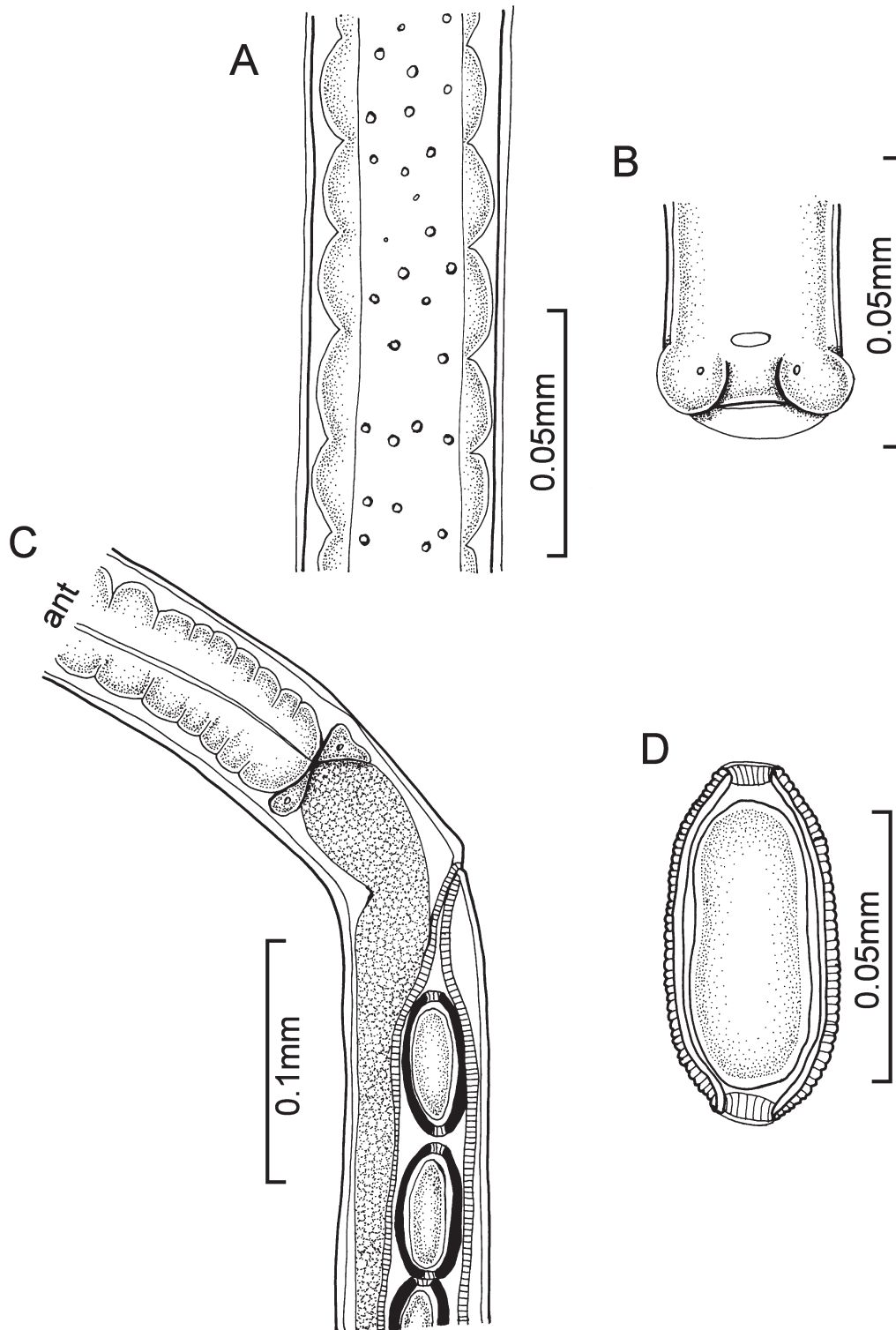


FIGURE 23. *Pseudocapillaria (Ichthyocapillaria) salvelini* (Polyanski, 1952) Moravec, 1982. A. stichosome region with marked bacillary band; B. male, tail, ventral view; C. female, vulvar region; D. egg. (Redrawn from Moravec 2001)

Key to the species of *Pseudocapillaria* from Canadian fresh-water fishes

- 1 Male tail with short dorsal caudal bursa connecting subventral lobes *P. (Ichthyocapillaria) salvelini*
- Male tail lacking caudal bursa connecting subventral lobes *P. (Pseudocapillaria) tomentosa*

***Pseudocapillaria (Ichthyocapillaria) salvelini* (Polyanski, 1952) Moravec, 1982**

Synonym: *Capillaria salvelini* Polyanski, 1952

Description (after Moravec 2001). With characteristics of the genus.

Males: Body length 6.17–9.11, maximum width 0.060–0.84. Muscular oesophagus 0.285–0.330, 26–35 stichocytes. Nerve ring 0.087–0.099 from anterior end. Spicule smooth, well sclerotized, 0.405–0.636 long, 0.009–0.012 wide. Tail 0.018–0.027 long, rounded, with caudal bursa (Fig. 23B).

Females: Gravid worms 7.15–13.46 long, maximum width 0.054–0.095. Muscular oesophagus 0.300–0.393 long. Nerve ring 0.095–0.102 from anterior extremity. Vulva 0.030–0.081 behind oesophago-intestinal junction. Eggs in one row near vulva (Fig. 23C), several rows distally. Mature eggs 0.060–0.075 x 0.027–0.030, polar plugs non-protruding (Fig. 23D). Anus subterminal. Tail 0.009–0.015 long.

Site: alimentary tract

Hosts: *Coregonus clupeaformis* (5, 12, 22); *Cottus asper* (14); *Oncorhynchus kisutch* (11, 14, 16, 17, 18, 21); *Oncorhynchus mykiss* (22); *Osmerus mordax* (6, 14); *Prosopium cylindraceum* (5, 11, 22); *Salmo salar* (2, 6, 7, 8, 9, 10, 14, 15, 17, 24, 25); *Salvelinus alpinus* (5, 23); *Salvelinus fontinalis* (3, 4, 5, 6, 12, 19, 20, 24); *Salvelinus fontinalis* x *Salvelinus namaycush* (13); *Salvelinus malma* (18); *Salvelinus namaycush* (5, 11, 12, 14, 17); *Thymallus arcticus* (11)

Distribution: British Columbia, Labrador, New Brunswick, Newfoundland, Northwest Territories, Nova Scotia, Ontario, Quebec, Yukon Territory

Records: 1. Pippy 1967 (NB, NL); 2. Pippy 1969 (NL, NB, NS); 3. Threlfall & Hanek 1969 (NF); 4. Threlfall & Hanek 1970c (NF); 5. Hicks & Threlfall 1973 (LB); 6. Hanek & Molnar 1974 (QC); 7. Hare & Burt 1975a (NB); 8. Hare & Burt 1975b (NB); 9. Hare 1975 (NB); 10. Hare & Burt 1976 (NB); 11. Arthur *et al.* 1976 (YT); 12. Chinniah & Threlfall 1978 (LB); 13. Dechtiar & Berst 1978 (ON); 14. Moravec 1980 (BC, NF, ON, YT); 15. Pippy 1980 (NB, NL, NT); 16. Anon. 1981 (BC); 17. Bell & Beverley-Burton 1981 (BC, NB, NT); 18. Anon. 1984 (BC); 19. Frimeth 1987a (NB); 20. Frimeth 1987b (NB); 21. Dechtiar & Christie 1988 (ON); 22. Dechtiar & Lawrie 1988 (ON); 23. Bouillon & Dempson 1989 (LB); 24. Marcogliese & Cone 1991a (LB, NB, NL, QC); 25. Marcogliese & Cone 1991b (NF)

***Pseudocapillaria (Pseudocapillaria) tomentosa* (Dujardin, 1843) Moravec, 1987**

Synonyms: *Capillaria catostomi* Pearse 1934; *Hepaticola bakeri* Mueller & Van Cleave, 1932 (*partim*); *Capillaria bakeri* (Mueller & Van Cleave, 1932) Freitas & Lent, 1935; *Skrjabinocapillaria bakeri* (Mueller & Van Cleave, 1932) Skryabin & Schikhobalova, 1954

Description (after Moravec 2001). With characteristics of the genus.

Males: Body length 3.95–7.18, maximum width 0.054–0.068. Muscular oesophagus 0.183–0.330 long. Nerve ring 0.084–0.099 from anterior end. Spicule smooth, well sclerotized, 0.240–0.330 long (Fig. 24A). Tail 0.015–0.018 long, rounded. Caudal bursa absent (Fig. 24B).

Females: Gravid worms 7.30–12.04 long, maximum width 0.068–0.108. Muscular oesophagus 0.258–0.321 long, nerve ring 0.090–0.096 from anterior end. Vulva usually a short distance, 0.030–0.066, behind oesophago-intestinal junction (Fig. 24C). Eggs in one row near vulva, several rows distally. Mature eggs 0.063–0.078 x 0.030–0.039. Anus subterminal, tail 0.009–0.015 long.

Site: intestine

Hosts: *Catostomus catostomus* (1, 3); *Catostomus commersonii* (1, 4, 6, 7, 8); *Catostomus macrocheilus* (3); *Coregonus clupeaformis* (8); *Cottus asper* (3); *Couesius plumbeus* (3); *Cyprinus carpio* (8); *Cyprinus carpio* x *Carassius auratus* (8); *Lota lota* (1, 2, 5); *Mylocheilus caurinus* (3); *Oncorhynchus clarkii* (3); *Oncorhynchus kisutch* (3); *Oncorhynchus mykiss* (3); *Prosopium williamsoni* (3); *Ptychocheilus oregonensis* (3); *Richardsonius balteatus* (3); *Salvelinus fontinalis* (2, 3); *Salvelinus malma* (3)

Distribution: British Columbia, Ontario

Records: 1. Bangham 1941 (ON); 2. Bangham & Venard 1946 (ON); 3. Bangham & Adams 1954 (BC); 4. Bangham 1955 (ON); 5. Dechtiar 1972a (ON); 6. Bell & Beverley-Burton 1980 (ON); 7. Moravec 1980 (ON); 8. Bell & Beverley-Burton 1981 (ON)

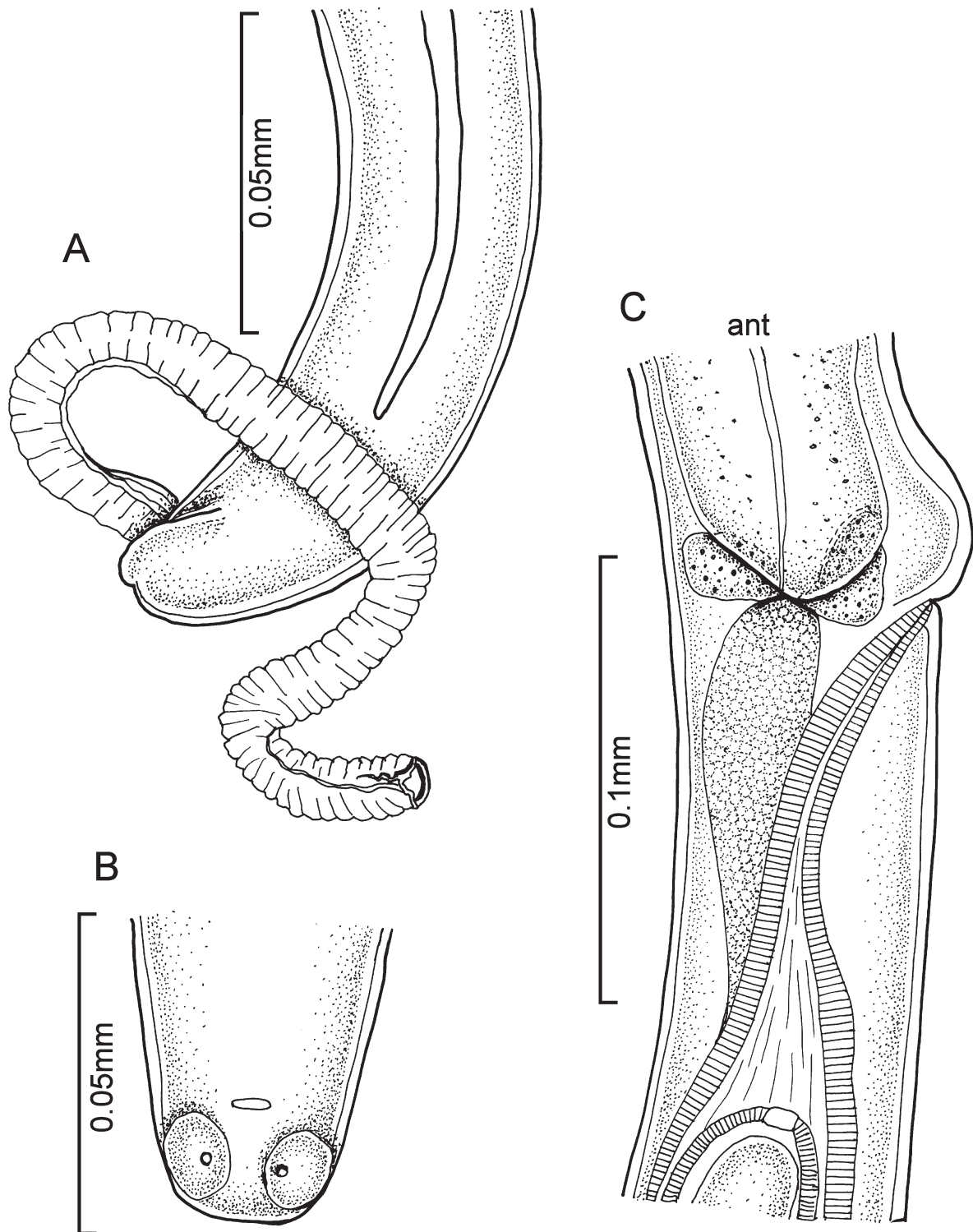


FIGURE 24. *Pseudocapillaria* (*Pseudocapillaria*) *tomentosa* (Dujardin, 1843) Moravec, 1987. A. male, posterior end, lateral view; B. male, tail, ventral view; C. female, vulvar region. (Redrawn from Moravec 2001)

Family TRICHOSOMOIDIDAE Hall, 1916

Preamble: Conboy & Speare (2002) speculated that *Huffmanella*-type eggs found in the skin of various species of *Sebastes* from coastal British Columbia might represent a new species. Indeed, Moravec, Conboy & Speare (2005) subsequently re-examined histologically the same rockfish material and recovered two complete males, three

complete females and worm fragments representing a new species, namely, *H. canadensis*. The nematode has commercial significance because infected rockfish with so-called “black mould” in the skin are downgraded in the market.

***Huffmanella* Moravec, 1987**

Generic diagnosis (after Moravec 2001, and Gibbons 2010). Trichosomoididae. Small thread-like nematodes. Stichosome comprises single row of stichocytes. Males: cloaca long, spicule and spicular sheath absent. Posterior end dorso-ventrally depressed, membranous pseudobursa absent. Tail with one pair of ad-cloacal papillae. Female: vulva opens near posterior end of oesophagus. Eggs in uterus, non-embryonated; eggs in host tissue contain larva, strongly pigmented, dark, not translucent, wall often distinctly thick, walls including polar plugs completely covered with clear membrane covered in minute spines or ornamentation. Anus terminal. Parasites in skin, mucosa of gill arches, muscles, swim bladder, serosal cover of elasmobranch and teleost intestine.

***Huffmanella canadensis* Moravec, Conboy & Speare, 2005**

Description (after Moravec *et al.* 2005). With characteristics of the genus.

Males (holotype measurements in parentheses): 3.441–3.862 (3.441) long, 0.045–0.063 (0.045) maximum width. Entire oesophagus 1.333–1.346 (1.333), muscular oesophagus 0.147–0.153 (0.153), and stichosome 1.180–1.199 (1.180) long; 40–42 (42) stichocytes (Fig. 25A). Nerve ring 0.048–0.069 (0.069) from anterior end. Single testis reaches anteriorly to near oesophago-intestinal junction (Fig. 25B). Cloaca long (0.093 in holotype). Tail slightly narrowed, rounded, bearing pair of large pre-anal papillae. Cloacal aperture slightly depressed (Fig. 25C).

Females (allotype measurements in parentheses): gravid worms 7.711–8.160 (17.711) long, 0.090–0.105 (0.090) maximum width. Entire oesophagus 1.768–2.054 (1.768), muscular oesophagus 0.180–0.216 (0.210), and stichosome 1.558–1.838 (1.558) long; 32–37 (35) stichocytes. Nerve ring 0.075–0.078 (0.078) from anterior end. Vulva slightly posterior to oesophago-intestinal junction, anterior vulvar lip elevated (Fig. 25D). Vagina short. Ovary single, posteriorly extending to end of intestine. Colourless rectum 0.111 (0.099) long, anus terminal (Fig. 25E). *In utero* eggs with polar plugs, oval, light coloured, non-embryonated, shell appears two-layered (Fig. 25F). Eggs 0.032–0.039 x 0.024–0.027 (0.036–0.039 x 0.024–0.027). Eggs in anterior uterus arranged in one row, two to three rows posteriorly.

Advanced eggs in host skin are dark brown, oval, with two-layered wall, surface with many transverse, somewhat oblique, complete or incomplete ridges. Polar plugs light coloured, height 0.006–0.009. Eggs including the polar plugs 0.048–0.063 (mean 0.054) x 0.024–0.027 (mean 0.026) containing a fully formed larva (Fig. 25G,H).

Sites: skin of fins and adjacent skin

Hosts: *Sebastes* spp.

Distribution: Pacific

Records: Conboy & Speare 2002; Moravec *et al.* 2005

Key to higher taxonomic ranks of the Class CHROMADOREA

- 1 Males with reduced number of caudal papillae; usually only one spicule; body short and stout; oesophagus with bulb; pre-cloacal sucker absent; large embryonated eggs often flattened on one side Infraorder Oxyuridomorpha
- Nematodes lacking most of the above characteristics 2
- 2 Anterior end triradiate (except in some Seuratoidea); lateral external labial papillae, and two to three pairs of dorso-lateral caudal papillae present; oesophagus variable but not comprising short muscular and long glandular portions; male pre-cloacal sucker present or absent Infraorder Ascaridomorpha
- Anterior end bilaterally symmetrical; lateral external labial papillae absent; caudal papillae ventral or ventro-lateral in position; oesophagus divided, anterior muscular portion shorter than posterior glandular portion; pre-cloacal sucker absent Rhabditida

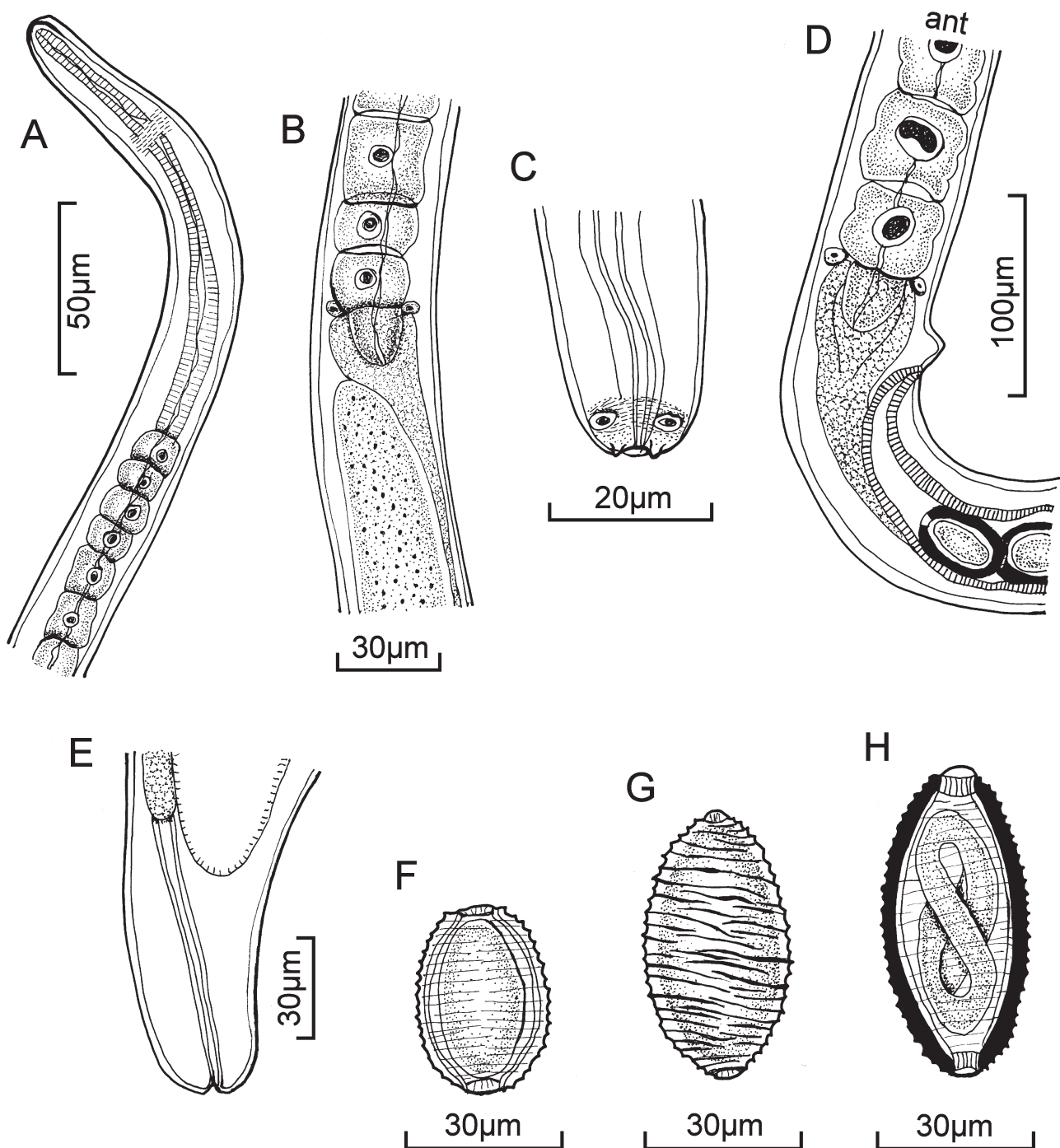


FIGURE 25. *Huffmanella canadensis* Moravec, Conboy & Speare, 2005. A. male, anterior end; B. male, oesophago-intestinal junction; C. male tail, ventral view; D. female, vulvar region; E. female tail, lateral view; F. most developed egg *ex* uterus; G. egg, dark, fully developed *ex* host tissue, showing surface ridges; H. egg, dark, fully developed, contains larva. (Redrawn from Moravec *et al.* 2005)

Order RHABDITIDA Chitwood, 1933

Key to Superfamilies of RHABDITIDA

- 1 Pseudolabia always absent; buccal capsule well developed, reduced or absent; oesophagus divided into muscular and glandular portions or muscular throughout; oesophageal glands uninucleate (except in *Philonema* and some species of *Philometroides*); larvae without cephalic hooks, tail generally long and pointed, usually with conspicuous phasmids containing broad cavities

- and prominent pores; parasitic in gut of cold-blooded vertebrates or other organs of all classes of vertebrates; intermediate hosts mostly copepods. (Suborder Camallanina)...2
- Head with small pseudolabia, sometimes rudimentary; buccal capsule usually an elongate, moderately sclerotized tube; muscular and glandular portions of oesophagus well differentiated; oesophageal glands multinucleate; larvae usually with cephalic hooks or spines and inconspicuous pore-like phasmids; parasitic in gut or tissues of all classes of vertebrates; intermediate hosts invertebrates other than copepods (except Gnathostomatoidea) (Suborder Spirurina) ... 3
 - 2 Buccal capsule well developed, orange-brown in colour; buccal cavity well developed; internal labial papillae tiny; parasitic in gut Camallanoidea
 - Buccal capsule reduced or absent (except for Anguilliculoidea); if buccal cavity present then simple, rounded, not separated into two valves; internal labial papillae prominent; not usually parasitic in gut3
 - 3 Oviparous. Buccal capsule well developed. Oesophagus short, undivided. Sclerotized copulatory organs absent. Vulva functional. Parasites of swim bladder of eels.Anguilliculoidea
 - Viviparous. Buccal capsule usually reduced or absent. Oesophagus divided into muscular and glandular portions or muscular throughout. Spicules, copulatory plate or sclerotized genital cone present. Anus and vulva in gravid worms sometimes atrophied. Parasites of tissues, body cavity or closed cavities and organs of vertebrates Dracunculoidea
 - 4 Buccal capsule well cuticularized, elongate or short. Pseudolabia present or absent 5
 - Buccal capsule little cuticularized; two massive lateral trilobed pseudolabia present; inner face of each pseudolabium thick, generally folded into rounded tooth-like formations that fit into corresponding folds on adjacent pseudolabium; anterior extremity sometimes swollen into bulb; adults parasitic in fishes, reptiles and mammals, larvae in fishes Gnathostomatoidea
 - 5 Pseudolabia practically absent; caudal alae absent 6
 - Pseudolabia present; caudal alae present or absent 7
 - 6 Buccal capsule variable, sometimes long and cylindrical; mouth opening hexagonal or oval; caudal papillae not arranged as in typical spirurid; vulva markedly anterior or posterior in position; adults parasitic in intestine of fishesThelazioidea
 - Buccal capsule well cuticularized, never long and cylindrical; caudal alae present; caudal papillae arranged as in typical spirurid; vulva rarely markedly anterior or posterior in position; larvae parasitic in fishes, adults in higher vertebrates . Spiruroidea
 - 7 Pseudolabia not covering entire cephalic surface, median lips still visible; four outer labial papillae often visible on lips; buccal cavity rarely long and cylindrical; cephalic cuticular ornamentation present or absent; adults parasitic in various organs of fishes Habronematoidea
 - Pseudolabia large, involving entire cephalic surface; outer labial papillae fused with cephalic papillae; buccal cavity generally elongated and cylindrical; cuticular cephalic ornamentation present; larvae parasitic in arthropods and fishes, adults in birds Acuarioidea
 - 8 Buccal cavity weakly developed; leaf crowns absent; bursa and often dorsal ray reduced; vulva at mid-body or posterior end; didelphic or monodelphic; viviparous or ovoviviparous; parasitic in the respiratory, cardiovascular and nervous systems of mammals Metastrongyloidea

Superfamily ANGUILLICOLOIDEA Yamaguti, 1935

Family ANGUILLICOLIDAE Yamaguti, 1935

Preamble: Five species of the eel swim bladder nematode *Anguillicola* are recognised currently: *A. globiceps* Yamaguti, 1935 (type species); *A. australiensis* Johnston & Mawson, 1940; *A. crassus* Kuwahara, Niimi & Itagaki, 1974; *A. novaezelandiae* Moravec & Taraschewski, 1988; and *A. papernai* Moravec & Taraschewski, 1988. Reports of *A. crassus* as an invasive species in American eels (*Anguilla rostrata*) in Canadian and other North American waters are of concern because the nematode causes morbidity and mortality in Japanese and European eels, *A. japonica* and *A. anguilla* (Laetsch *et al.* 2012). Molecular analyses by Laetsch *et al.* (*op. cit.*) do not support Moravec's (2006) division of the Family Anguillicolidae Yamaguti, 1935, into the genera *Anguillicola* Yamaguti, 1935, and *Anguillicoloides* Moravec & Taraschewski, 1988. Further analyses might not support Moravec & Taraschewski's (1988) erection of the subgenera *Anguillicola* and *Anguillicoloides* within *Anguillicola*. Indeed, in an exploration of spirurine evolutionary relationships Wijová, Moravec, Horák & Lukeš (2006) referred, without comment, to the binomen *Anguillicola crassus*; they also stated that "the genus *Anguillicola* should be evaluated within an independent Superfamily Anguilliculoidea, whose position within a higher taxonomic unit remains uncertain at best". Future molecular analyses might shed light on such problems.

Evidence that forage fish species in North America serve as paratenic hosts of *Anguillicola crassus* was provided by Li *et al.* (2015). Of Canadian interest was the finding of two *A. crassus* L3 in one of nine Atlantic tomcod (*Microgadus tomcod*) from the Mira River, Cape Breton, Nova Scotia; one of these L3 was 846µm long and 33µm wide.

Family diagnosis (after Moravec 2013). Buccal capsule well developed, with numerous peribuccal teeth. Cuticle smooth, spinose or with papilla-like excrescences. Four submedian cephalic papillae present. Oesophagus

short, undivided. Males with common cloacal duct opening on prominent process. Preanal and postanal papillae present. Vulva well developed, situated in posterior half of body. Parasites of swim bladder of eels.

***Anguillicola* Yamaguti, 1935**

Generic diagnosis (after Moravec & Taraschewski 1988, and Moravec 2013). Anguillicolidae. Cuticle aspinose, sometimes with irregularly scattered excrescences of fibrous material on anterior and posterior ends of the body. Head end with four submedian papillae and two lateral amphids. Buccal capsule small or medium sized with row of small circumoral teeth. Oesophagus short, undivided; anterior end lacks inflation, posterior end expanded, valvular apparatus well developed. Intestine dark, distended posteriorly. Rectal glands large. Spicules absent. Testis begins near tail end; seminal vesicle well developed. *Ductus ejaculatorius* opens on prominent caudal process. Preanal and postanal papillae present. Vulva opens on tip of prominent cone in posterior part of body. Uterus amphidelphic. Eggs contain ensheathed 2nd-stage larvae. Parasites of swim bladder of eels.

***Anguillicola crassus* Kuwahara, Niimi & Itagaki, 1974**

Synonyms: *Anguillicola (Anguillicoloides) crassus* (Kuwahara, Niimi & Itagaki, 1974) Moravec & Taraschewski, 1988; *Anguillicoloides crassus* (Kuwahara, Niimi & Itagaki, 1974) Moravec, 2006

Description (after Moravec 2013). With characteristics of the genus. Body darkly coloured, fusiform, rather plump, both ends tapering. Epicuticle almost smooth. Head end rounded. Mouth aperture circular, surrounded by four large dorso-lateral and ventro-lateral cephalic papillae and two small lateral amphids. Buccal capsule heavily sclerotized, its anterior rim bearing a row of 21 to 28 large circumoral teeth (Fig. 26A). Oesophagus strongly muscular, expanded posteriorly, with a well developed valvular apparatus. Nerve ring at about one-third oesophagus length from anterior end, and excretory pore near oesophageal-intestinal junction. Intestine dark, distended posteriorly (Fig. 26B). Three large and one small rectal glands, tail conical, very short (Fig. 26C,D).

Males: 5.77–23.12 long, 0.34–1.77 maximum width. Buccal capsule 0.021–0.027 long, 0.048–0.063 wide. Oesophagus 0.571–0.843 long, 0.135–0.258 maximum width. Oesophageal valves 0.054–0.095 long. Nerve ring and excretory pore respectively 0.210–0.286 and 0.694–0.924 from anterior end. Seminal vesicle well developed. Common cloacal duct opens on prominent process 0.048–0.090 long. Usually six pairs of caudal papillae: two to three preanal, one adanal, two to three postanal (Fig. 26D). Tail conical, 0.109–0.286 long.

Females: gravid worms 13.08–44.74 long, 1.22–5.00 maximum width. Buccal capsule 0.024–0.027 long, 0.054–0.063 wide. Oesophagus 0.775–1.090 long, 0.204–0.381 maximum width. Nerve ring and excretory pore respectively 0.258–0.299 and 0.857–1.142 from anterior end. Vulva prominent, cone shaped, 3.40–7.01 from posterior end (Fig. 26E). Uterus occupies most of the body space, containing numerous eggs with developing embryos or ensheathed 2nd-stage larvae 0.244–0.258 long and 0.015 wide (Fig. 26F). Rectum usually opens into a well-developed papilla-like process. Tail conical, 0.136–0.448 long (26C).

Sites: swim bladder (eels); mesenteries, intestinal wall (paratenic hosts)

Hosts: *Anguilla rostrata* (1, 2, 3, 4); *Microgadus tomcod* (5)

Distribution: New Brunswick, Nova Scotia

Records: 1. Aieta & Oliveira 2009 (NB, NS); 2. Rockwell *et al.* 2009 (NS); 3. Campbell *et al.* 2013 (NB, NS); 4. Denny *et al.* 2013 (NS); 5. Li *et al.* 2015 (NS)

Superfamily DRACUNCULOIDEA Stiles, 1907

Key to Families of DRACUNCULOIDEA

- | | | |
|---|---|-----------------|
| 1 | Vulva anterior or pre-equatorial, well developed in mature female; monodelphic or didelphic. | 2 |
| - | Vulva posterior or equatorial, more or less completely atrophied in mature female; two ovaries present | Philometridae |
| 2 | Spicules present; caudal alae in male absent or reduced | Guyanemidae |
| - | Spicules absent; caudal alae in male absent | Daniconematidae |

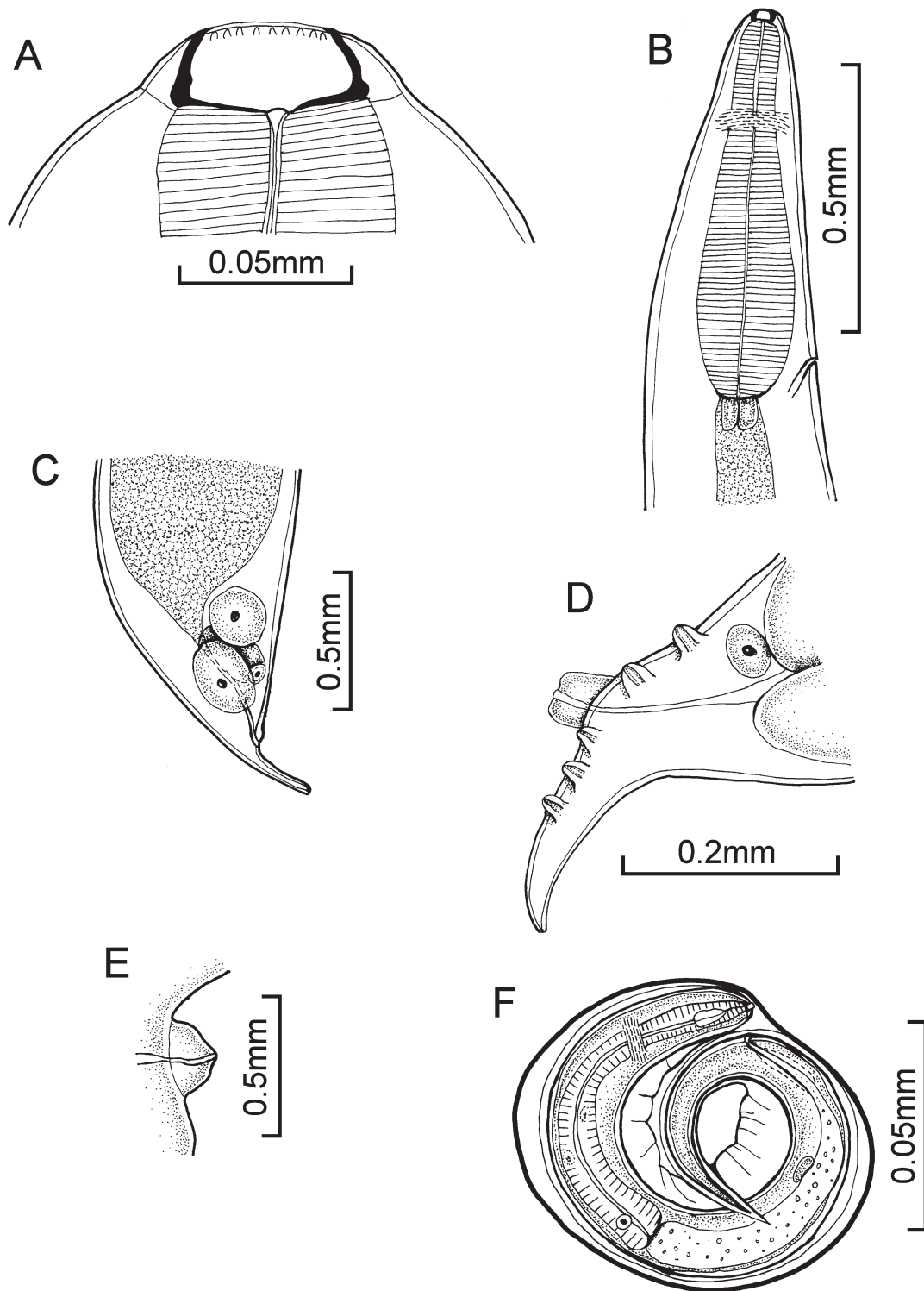


FIGURE 26. *Anguillicola crassus* Kuwahara, Niimi & Itagaki, 1974. A. female, buccal capsule; B. male, anterior end; C. female, tail; D. male, tail with five rather than the usual six caudal papillae; E. vulva; F. egg containing 2nd-stage larva. (Redrawn from Moravec 2013)

Family DANICONEMATIDAE Moravec & Køie, 1987

Family diagnosis (after Moravec 2013). Body thread-like. Head end with pair of prominent labial papillae and eight external paired papillae. Buccal capsule absent. Oesophagus muscular, with long, posteriorly extending,

oesophageal gland. Tail of male long, without caudal alae, provided with several pre-cloacal and post-cloacal papillae. Spicules or sclerotized copulatory plate absent. Cloacal opening on special genital projection. Vulva in anterior part of body. Monodelphic. Viviparous. Parasites of eels.

This Family appears to be represented by only one genus, *Daniconema*.

***Daniconema* Moravec & Køie, 1987**

Generic diagnosis (after Moravec 2013). Daniconematidae. Body thread-like, head bluntly rounded, with pair of large dome-shaped forwardly directed papillae (cephalic elevations); there are also eight external paired papillae (two ventro-ventral, two latero-ventral, two dorso-lateral, two dorso-dorsal) and pair of lateral amphids (Fig. 27A). Buccal capsule absent. Oesophagus muscular. Oesophageal gland highly developed, very long, extending posteriorly along intestine. Nerve ring encircling oesophagus in its anterior half, with excretory pore slightly below nerve ring level. Male tail long, lacking caudal alae; four pairs pre-cloacal and five pairs post-cloacal papillae. Spicules, gubernaculum or sclerotized copulatory plate absent; common cloacal duct opening on lobular genital projection. Female with functional anus. Female tail conical with rounded tip. Most of female body filled with uterus containing larvae. Vulva in anterior part of body. Monodelphic. Viviparous. Parasites of eels.

Type and apparently only species *D. anguillae* Moravec & Køie, 1987.

***Daniconema anguillae* Moravec & Køie 1987**

Description (after Moravec 2013). With characteristics of the genus. Fine, thread-like worms with slightly striated cuticle. Head papillae and absence of buccal capsule as described above for the genus. Junction of muscular oesophagus and intestine somewhat submerged into oesophageal gland (Fig. 27B). Position of nerve ring and excretory pore as described above for genus. Deirids not observed. Intestine a fine narrow tube. Gravid females two to three times longer than males.

Males: 7.48–8.81 long; maximum width 0.041–0.051. Cephalic elevations 0.006 high. Muscular oesophagus 0.501–0.540, and oesophageal gland 2.04–2.96 long. Nerve ring and excretory pore 0.210–0.219 and 0.233–0.243 respectively from anterior end. Anterior end of testis near end of oesophageal gland. Caudal end spirally coiled; caudal alae absent. Four pairs pre-cloacal papillae, all subventral; five pairs post-cloacal papillae, four subventral and one lateral (Fig. 27C). Spicules, gubernaculum and sclerotized plate absent. Common cloacal duct opening on peculiar large, lobular genital projection. Tail conical, sharply pointed, 0.114–0.141 long (Fig. 27C).

Females: Gravid worms 16.82–31.17 long; maximum width 0.081–0.095. Muscular oesophagus 0.666–0.680, and oesophageal gland 2.68–2.70 long. Nerve ring and excretory pore 0.270–0.381 and 0.299–0.408 respectively from anterior end. Anus functional. Tail conical, rounded tip, 0.144–0.162 long. Monodelphic. Posterior end of ovary reaches tail. Uterus very long, occupies much of body, contains eggs, developing embryos and fully formed larvae about 0.5 long. Vulva well developed, 0.830–0.966 from anterior end. Narrow, thin-walled vagina extending anteriorly from uterus along most of length of oesophageal gland; ovijector oval in shape.

Site: swim bladder

Host: *Anguilla rostrata*

Distribution: Atlantic, Nova Scotia

Records: Marcogliese & Cone 1996 (NS); Marcogliese & Cone 1998 (AT)

Family GUYANEMIDAE Petter, 1975

Family diagnosis (after Petter 1975, and Adamson & Roth 1990). Head with four cephalic papillae, and four internal and four external labial papillae. Buccal capsule reduced or absent; peribuccal ring present. Oesophagus comprises short muscular portion and longer, cylindrical glandular portion. Female tail long. Functional anus present in mature worms. Functional vulva situated anteriorly. Monodelphic or didelphic. Male tail long, with pre- and post-cloacal papillae; caudal alae present or absent. Two equal spicules. Viviparous. Parasites of fishes.

As presently defined Guyanemidae consists of two genera, namely, *Guyanema* Petter, 1975, and *Pseudodelphis* Adamson & Roth, 1990. Only *Pseudodelphis* has been recorded from Canadian fishes.

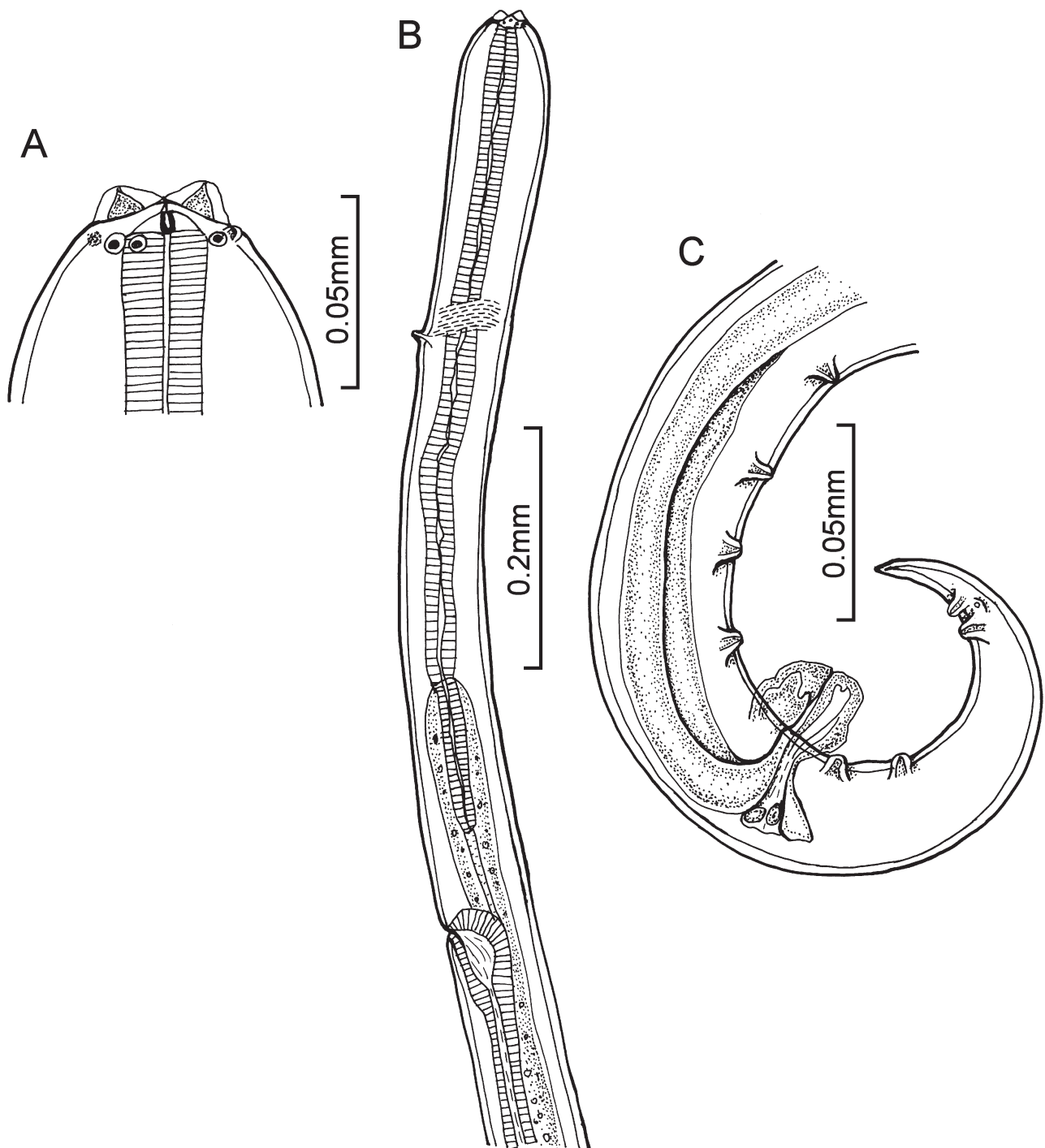


FIGURE 27. *Daniconema anguillae* Moravec & Køie, 1987. A. female, head, lateral view; B. female, anterior end, lateral view; C. male, posterior end, lateral view. (Redrawn from Moravec 2013)

***Pseudodelphis* Adamson & Roth, 1990**

Generic diagnosis (after Adamson & Roth 1990). Guyanemidae. Buccal capsule reduced to peribuccal ring. Oesophagus long with distinct muscular and glandular portions. Males lack caudal alae; caudal extremity subconical, simple. Females didelphic, anterior uterus ending blindly without associated oviduct and ovary. This genus appears to be monotypic, being represented only by *P. oligocotti* Adamson & Roth, 1990.

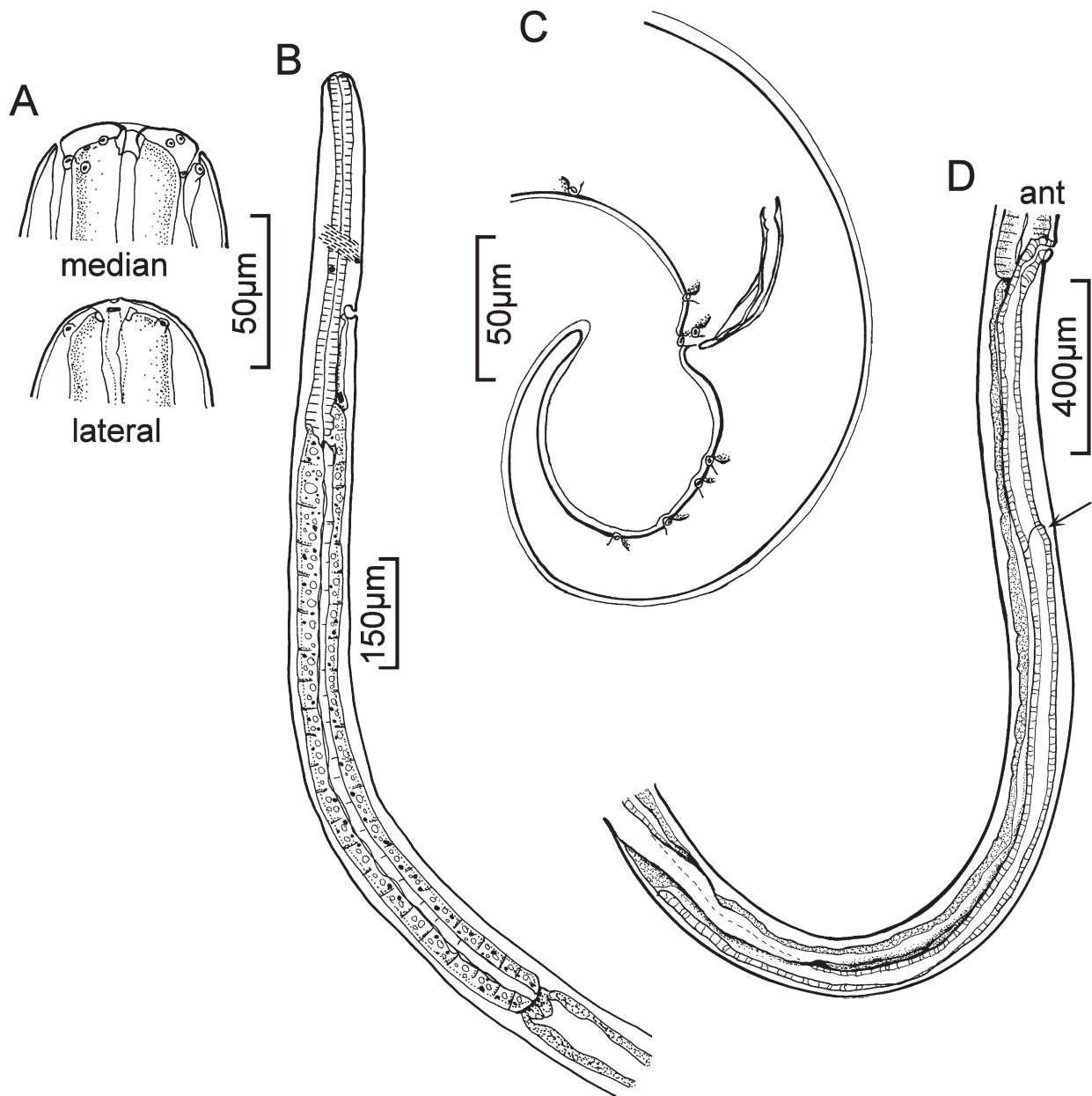


FIGURE 28. *Pseudodelphis oligocotti* Adamson & Roth, 1990. A. male, head, median and lateral views; B. male, anterior end, oesophageal region, lateral view; C. male, posterior end, lateral view; D. female, vaginal region, lateral view—arrow indicates anterior extremity of uterine diverticulum. (Redrawn from Adamson & Roth 1990)

Pseudodelphis oligocotti, Adamson & Roth 1990

Description of *P. oligocotti* (after Adamson & Roth 1990). With characteristics of the genus. Long, slender worms. Head end rounded, slightly wider in median than lateral view (Fig. 28A). Mouth opening subtriangular, dorso-ventrally elongate, surrounded by inner ring of six and outer ring of eight papillae. Papillae of inner ring similar; those of outer ring arranged in four pairs of which the more median element of each pair is smaller. Buccal capsule a simple cuticularized ring surrounded by oesophageal tissue. Oesophagus slightly swollen at anterior end, and comprising anterior muscular and posterior glandular portion. Nerve ring and hemizonid prominent. Excretory pore inconspicuous, leading by slender tubular duct to ventral excretory cell just anterior to glandular oesophagus. Deirids in form of small digitiform projections between level of nerve ring and excretory pore.

The following measurements are means for nine male and eight female *P. oligocotti*, with measurements of types in parentheses.

Males: 16.28 (18.0) long; maximum width 0.128 (0.125). Muscular oesophagus 0.561 (0.457) and glandular oesophagus 1.054 (0.898) long. Nerve ring 0.294 (0.279), excretory pore 0.416 (0.417), and anterior extremity of testis 2.793 (1.97) from anterior end (Fig. 28B). Spicule 0.064 (0.070) and tail 0.205 (0.218) long. Testis unflexed, extending posteriorly as broad tube filled with developing sperm. Tail subconical with anus elevated on slightly developed genital cone. Two pairs pre-cloacal, two pairs ad-cloacal, and four pairs post-cloacal caudal papillae (occasionally ad-cloacal pairs number three on one side, and post-cloacal five on one side). Cuticular prominence on anterior anal lip with 1 median pre-cloacal papilla. Phasmids between 1st and 2nd post-cloacal papilla pair. Tail conical with rounded end, coiled in a dextral spiral in more mature worms (Fig. 28C).

Gravid females: 26.87 (32.1) long [none contained eggs with 1st-stage larvae]; maximum width 0.169 (0.140). Muscular oesophagus 0.618 (0.704) and glandular oesophagus 1.490 (1.677) long. Nerve ring 0.274 (0.311), excretory pore 0.362 (0.416), and vulva 2.149 (2.661) from anterior end. Vagina 5.576 (3.465) long. Blind end of ovary 1.297 (1.464) from anus. Tail subconical with rounded end, 0.253 (0.279) long. Didelphic. Vagina in region of base of oesophagus, extends posteriorly to join with anterior and posterior uteri (Fig. 28D). Anterior uterus ends blindly about 0.500 posterior to base of oesophagus. Posterior uterus extends posteriorly to join oviduct and ovary.

Sites: body cavity, mesenteries

Hosts: *Apodichthys flavidus* (3); *Artedius lateralis* (3); *Gasterosteus aculeatus* (3); *Gobiesox maeandricus* (2, 3); *Leptocottus armatus* (2, 3); *Oligocottus maculosus* (1, 2, 3); *Pholis laeta* (2, 3); *Pholis ornata* (2, 3); *Syngnathus leptorhynchus* (2, 3)

Distribution: Pacific

Records: 1. Adamson & Roth 1990; 2. Bennett & Adamson 1994; 3. Bennett & Adamson 2004

Family PHILOMETRIDAE Baylis & Daubney, 1926

Family diagnosis (after Moravec 2013). Female body long. Head end rounded, peribuccal ring absent. Mouth simple, buccal capsule absent. Mouth opening usually surrounded by four to eight cephalic papillae. Males much smaller than females. Two equal or slightly unequal spicules; gubernaculum present or absent. Vulva and vagina more or less completely atrophied in gravid worms. Uterus amphidelphic. Viviparous. Parasitic in subcutaneous tissues, body cavity, serosa or blood vessels of fishes.

Key to genera of PHILOMETRIDAE

- | | | |
|---|--|-----------------------|
| 1 | Body elongate, claviform; oesophageal gland limited to middle of oesophagus | <i>Clavinema</i> |
| - | Body cylindrical, long; oesophageal gland more or less extensive | 2 |
| 2 | Dorsal oesophageal gland developed along greater posterior portion of oesophagus; anterior muscular portion more or less swollen anteriorly, without free posterior glandular appendix; anterior ovary not rudimentary | 3 |
| - | Anterior muscular portion of oesophagus elongate, with two swellings separated by nerve ring, with free posterior glandular appendix; anterior ovary rudimentary | <i>Ichthyofilaria</i> |
| 3 | Body of female covered with prominent cuticular bosses | <i>Philometroides</i> |
| - | Body of female smooth, without cuticular bosses | 4 |
| 4 | Posterior end of both sexes rounded; anus of male terminal; gubernaculum present | <i>Philometra</i> |
| - | Posterior end of both sexes tapering to a sharp point; tail of male coiled, anus remote from tail tip; gubernaculum absent | <i>Philonema</i> |

Clavinema Yamaguti, 1935

Generic diagnosis (after Yamaguti 1935). Philometridae. Body elongate, claviform, with thick muscular wall. Head and tail papillae absent. Anterior end of oesophagus bulbous, strongly muscular; posterior portion longer and cylindrical, with small oesophageal gland at about its middle. Intestine voluminous anteriorly. Ovaries amphidelphic. Uterus extends most of body length, distended with eggs, anteriorly especially. Vulva and vagina atrophied or absent. Viviparous. Males unknown. Parasites of fishes.

One species, *C. mariae*, is known from several fish species in Canada.

***Clavinema mariae* (Layman, 1930) Yamaguti, 1935**

Synonyms: *Philometra mariae* Layman, 1930; *Philometra americana* Kuitunen-Ekbaum, 1933; *Philometra* sp. of Arai (1967 *partim*)

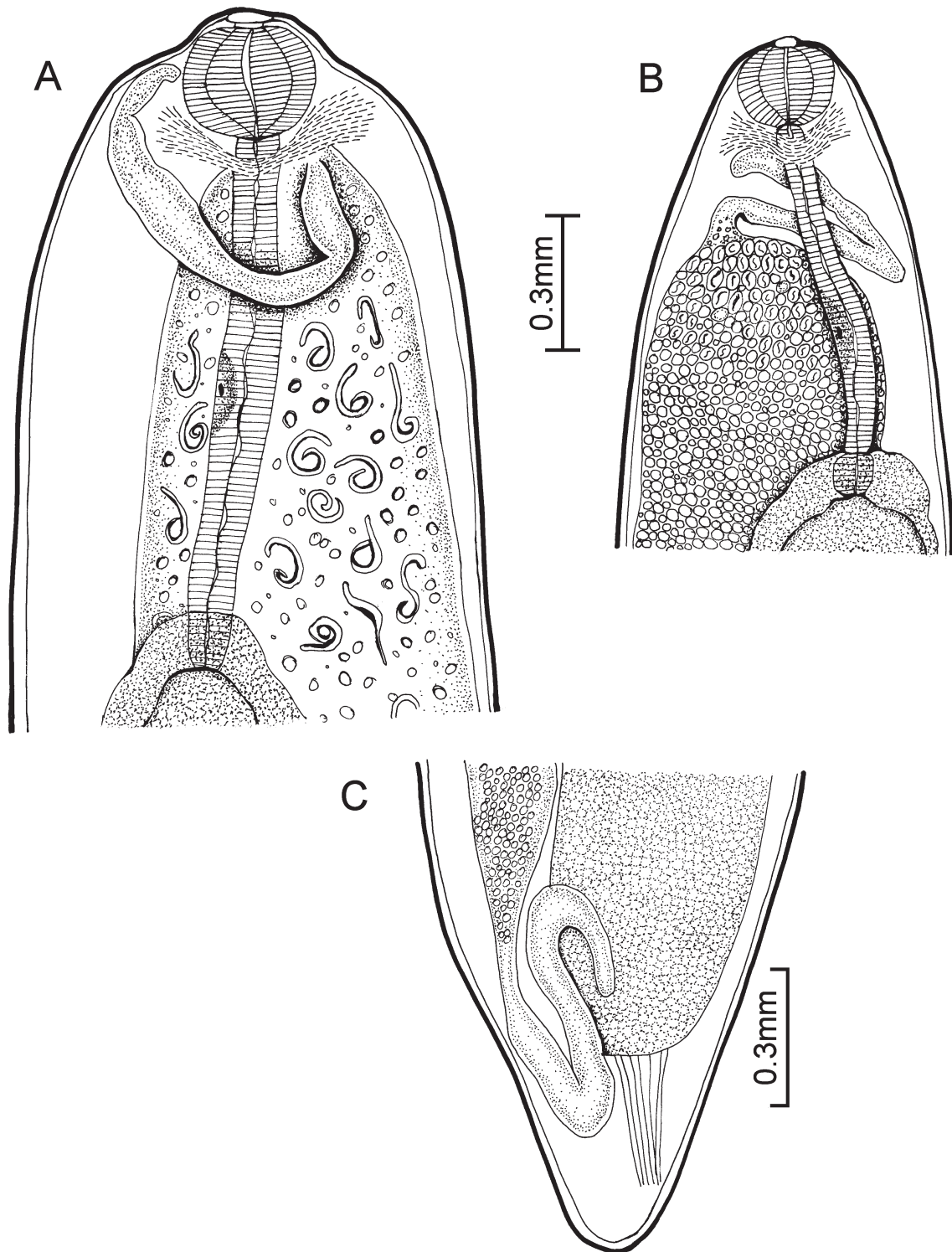


FIGURE 29. *Clavinema mariae* (Layman, 1930) Yamaguti, 1935. A. gravid female, anterior end; B. subgravid female, anterior end; C. gravid female, posterior end. (Redrawn from Margolis & Moravec 1987)

Description (after Margolis & Moravec 1987). With characteristics of the genus.

Males unknown.

Females: body of gravid and subgravid worms distinctly narrower in posterior half. Cuticle smooth. 23.6–48.5 long; maximum width 0.74–1.90. Gravid worms with larvae in uteri 33.7–48.5 long; maximum width 0.74–1.49. Head end rounded, with elevated oesophageal bulb region (0.115 long and 0.322 wide) in larger worms. Mouth papillae not observed. Mouth slightly depressed. Anterior end of oesophagus forming a conspicuous, strongly muscular bulb, well separated from posterior cylindrical portion of oesophagus; bulb 0.202–0.326–0.235–0.398. Small, not well demarcated oesophageal gland situated about middle of posterior portion of oesophagus. Entire oesophagus including bulb 0.958–1.442 long (Fig. 29A). Oesophagus opens into intestine through distinct valves. Nerve ring encircles anterior end of cylindrical portion of oesophagus, 0.281–0.446 from anterior end (Fig. 29A). Intestine dark and broad throughout, attached by short ligament to ventral body wall near posterior end (Fig. 29C). Uterus containing eggs, developing embryos, and larvae. Larvae 0.300–0.426 long and 0.009–0.018 maximum width. Vulva absent. Uterus reaches anteriorly to posterior end of oesophageal bulb in gravid worms (Fig. 29A) or near it in subgravid worms (Fig. 29B). Anterior ovary tubular, well developed. Posterior ovary directed anteriorly, its distal end pointing backwards. Uterus reaching posteriorly almost to posterior end of intestine. Posterior end of body rounded, lacking projections or papillae (Fig. 29C).

Sites: body cavity, fins, musculature, subcutaneous

Hosts: *Anoplarchus purpureus* (2); *Cottus asper* (9); *Gobiesox maeandricus* (1, 2); *Parophrys vetulus* (3, 4, 7); *Pholis laeta* (5, 6); *Pholis ornata* (1, 2); *Platichthys stellatus* (1, 2, 4, 8); *Paraplagusia bilineata* (1, 2); *Xiphister atropurpureus* (1, 2)

Distribution: British Columbia, Pacific

Records: 1. Kuitunen-Ekbaum 1933c (PA); 2. Kuitunen-Ekbaum 1938 (PA); 3. Margolis 1952a (PA); 4. Margolis 1952b (PA); 5. Arai 1967a (PA); 6. Arai 1969 (PA); 7. Margolis 1970 (PA); 8. Lewis 1978 (PA); 9. Margolis & Moravec 1987 (BC, PA)

Ichthyofilaria Yamaguti, 1935

Generic diagnosis (after Yamaguti 1961). Philometridae. Body cylindrical, with tapered extremities. Mouth simple. Oesophagus comprises anterior muscular portion with two swellings separated by nerve ring, and a shorter posterior portion. Vermiform glandular appendix arises from posterior end of muscular portion of oesophagus, and extends backwards dorsal to the posterior portion of oesophagus and terminating on anterior end of intestine. Anterior ovary poorly developed, posterior ovary long, cylindrical, reaching to near tail end. Uterus continuous. Viviparous. Males unknown. Parasites of fishes.

One species, namely *I. canadensis*, is known from two species of *Lycodes* in Canadian waters.

***Ichthyofilaria canadensis* Appy, Anderson & Khan, 1985**

Description (after Appy *et al.* 1985). With characteristics of the genus.

Males unknown.

Holotype (gravid female): 22 long; maximum width 0.275. Anterior part of body narrows abruptly at excretory pore level; anterior end bluntly rounded. Posterior part of body tapers to pointed tip. Mouth opening circular, surrounded by delicate cuticular ring. Four poorly defined median cephalic papillae present. Amphidial pores prominent. Muscular portion of oesophagus 0.275 long, swollen anterior and posterior to nerve ring. Glandular part of oesophagus about 0.100 long, extending slightly into intestine. Oesophageal gland with several nuclei and extending posterior to oesophago-intestinal junction as vermiform appendix. Nerve ring 0.180 and excretory pore 0.295 from anterior end (Fig. 30A). Intestine inflated anteriorly, contains fine granular material; posteriorly, intestine reduced to ligament attached to hypodermis 0.303 from posterior end. Anus apparently not patent (Fig. 30B). Vulva 14.5 from anterior end; vagina narrow, directed posteriorly before dividing into uteri (Fig. 30C). Uteri amphidelphic, didelphic, thin-walled and filled with 1st-stage larvae (microfilaroid in form and ensheathed) and developing embryos. Anterior ovary narrow, poorly developed, and extending to oesophageal region. Posterior ovary well developed, reflexed, and ending in narrow ligament attached to hypodermis adjacent to intestinal ligament (Fig. 30B).

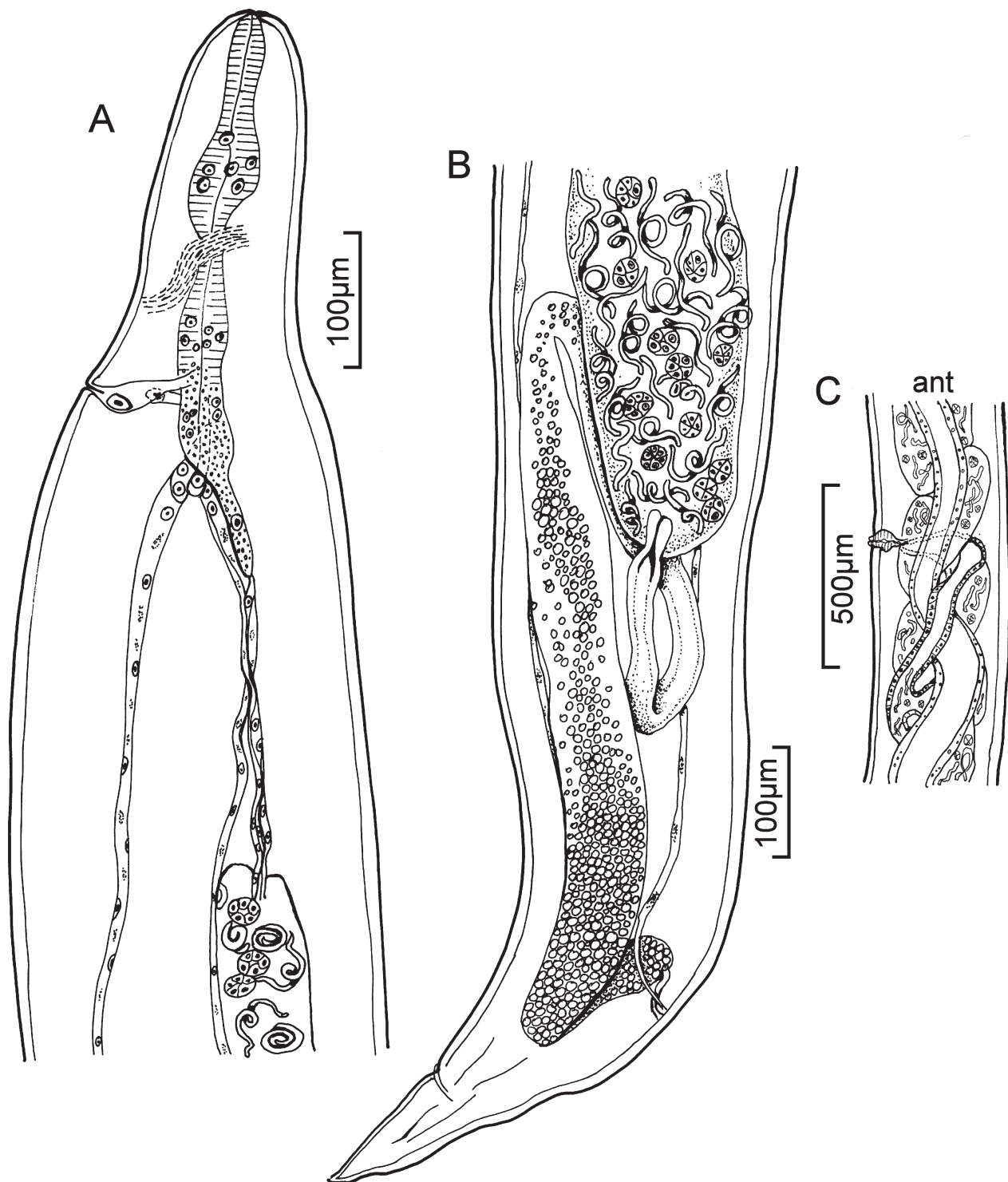


FIGURE 30. *Ichthyofilaria canadensis* Appy, Anderson & Khan, 1985. A. holotype, anterior end, lateral view; B. holotype, posterior end, lateral view; C. paratype, vulva and vagina, lateral view. (Redrawn from Appy *et al.* 1985)

Paratypes (15 gravid worms): 19 (8–28) long; maximum width 0.313 (0.127–0.469). Nerve ring 0.185 (0.155–0.229) and excretory pore 0.330 (0.242–0.447) from anterior end. Total length oesophagus 0.382 (0.263–0.375). Vulva 12.2 (4.6–18.7) from anterior end. Anus 0.320 (0.259–0.389) from posterior end.

Sites: body cavity, mesenteries

Hosts: *Lycodes lavalaei*; *Lycodes vahlii*

Distribution: Atlantic

Record: Appy *et al.* 1985

***Philometra* Costa, 1845**

Generic diagnosis (after Yamaguti 1961). Philometridae. Males much smaller than females (males of some species unknown). Body filiform, anterior and posterior ends rounded. Mouth with or without lips. Head and tail papillae present or absent. Oesophagus cylindrical, short, bulbous at anterior end. Oesophageal gland confined to wall of oesophagus. Males with spicules equal, or almost so, slender; gubernaculum present. Vulva of gravid worms atrophied. Uteri occupy most of body. Ovaries amphidelphic. Parasites of body cavity and tissues of fishes.

Key to species of *Philometra*

- 1 Female mouth opening oval; 14 cephalic papillae arranged in two circles; subgravid worms < 60 mm long; oesophagus relatively long (> 3 mm) *P. rubra*
- Female mouth opening round; four cephalic papillae; gravid worms > 90 mm long; oesophagus relatively short (< 3 mm) . . . 2
- 2 Female tail rounded, bearing two small lateral papillae *P. cylindracea*
- Female tail tapers, bearing small dorsally directed papilla *P. kobuleji*

***Philometra cylindracea* (Ward & Magath, 1917) Van Cleave & Mueller, 1934**

Synonym: *Ichthyonema cylindracea* Ward & Magath, 1917

Description (after Molnar & Fernando 1975a). With characteristics of the genus.

Males: transparent, minute, 2.7 (2.5–2.8) long. Greatest width close to posterior end, 0.035 (0.031–0.041); at nerve ring level, 0.025 (0.021–0.031). Cuticle smooth and thin. Head rounded; papillae not observed. Mouth three-lobed. Oesophagus a muscular tube 0.615 (0.572–0.680) long, with a well-developed oesophageal gland alongside. Intestine narrow. Tail end blunt, with two lateral papillae connected by a narrow inconspicuous membrane. Spicules relatively short, subequal, right one 0.060 (0.049–0.071), left one 0.061 (0.049–0.075). Gubernaculum 0.038 (0.034–0.043) long, in the form of a bent chitinous plate with a spear-like posterior end (Fig. 31A).

Females: Fully developed worms are coloured red and 97 (91–102) long. Body cylindrical, tapering slightly at both extremities; greatest width 0.9 (0.8–1.0). Cuticle thin and smooth. Body cavity filled by uterus full of larvae. Head rounded, with three lips and four inconspicuous papillae (Fig. 31B). Caudal end also rounded, showing two small lateral papillae (Fig. 31C). Oesophagus 2.3 (2.0–2.9) long, muscular and forming a bulb near mouth. Oesophageal gland very prominent with clearly visible nucleus at its centre (Fig. 31B). Intestine greater in width than posterior portion of oesophagus. Vulva atrophied. Two long, thin ovaries run in opposite directions connected by common uterine duct. Anterior ovary bent backwards near nerve ring region, the posterior one bent forwards at terminal end of intestine. Uterus packed with vigorously moving larvae; larvae are 0.36 (0.31–0.39) long and have rounded anterior ends and sharply attenuated tails (Fig. 31B,C).

Site: body cavity

Hosts: *Aplodinotus grunniens* (1); *Perca flavescens* (1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12); *Salvelinus fontinalis* (2, 13); *Sander vitreus* (1)

Distribution: Ontario, Quebec

Records: 1. Bangham & Hunter 1939 (ON); 2. Fantham & Porter 1948 (QC); 3. Bangham 1955 (ON); Tedla 1969 (ON); 4. Tedla & Fernando 1969a (ON); 5. Tedla & Fernando 1972 (ON); 7. Dechtiar 1972a (ON); 8. Molnar *et al.* 1974 (ON); 9. Molnar & Fernando 1975a (ON); 10. Dechtiar & Christie 1988 (ON); 11. Dechtiar & Nepszy 1988 (ON); 12. Dechtiar *et al.* 1988 (ON); 13. Marcogliese & Cone 1991a (QC)

***Philometra kobuleji* Molnar & Fernando, 1975**

Description (after Molnar & Fernando 1975b). With characteristics of the genus.

Males: minute, transparent, 2.1–3.0 (2.5) long. Cylindrical body tapers slightly at anterior end. Greatest width, 0.056–0.061 (0.059) near tail end. Cuticle smooth and thin. Head rounded, papillae not observed. Mouth simple,

with three lips. Oesophagus muscular, slightly swollen near mouth, 0.375–0.440 (0.418) long (Fig. 32A). Tail end blunt, with two prominent lateral papillae connected by inconspicuous membrane. Two spicules, almost equal; right one 0.109–0.134 (0.120), left one 0.106–0.126 (0.115) long. Gubernaculum a bent chitinous plate with spear-like end, 0.065–0.074 (0.072) long (Fig. 32B). Anus opens ventrally near posterior end.

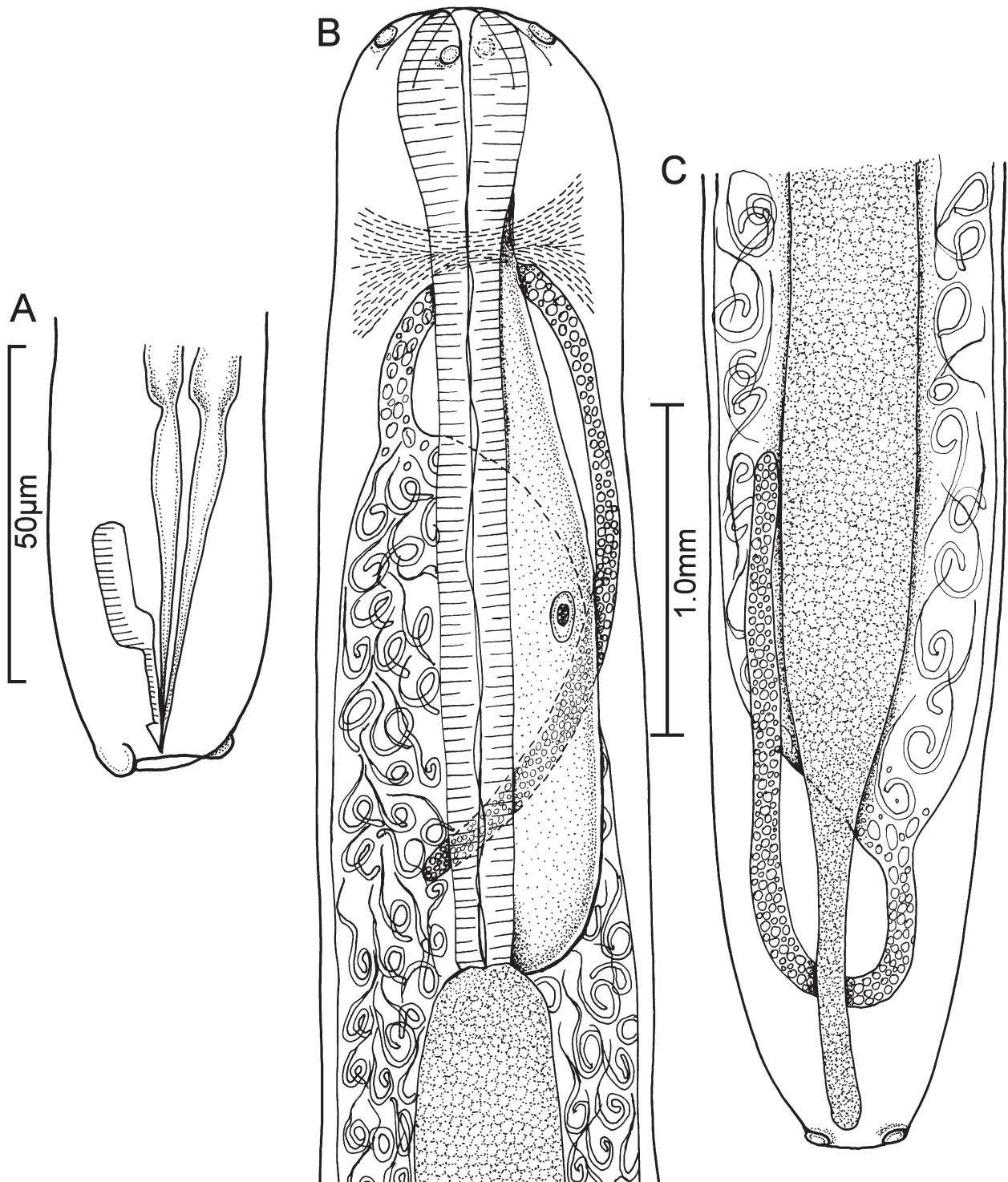


FIGURE 31. *Philometra cylindracea* (Ward & Magath, 1917) Van Cleave & Mueller, 1934. A. male, posterior end; B. female, anterior end; C. female, posterior end. (Redrawn from Molnar & Fernando 1975a)

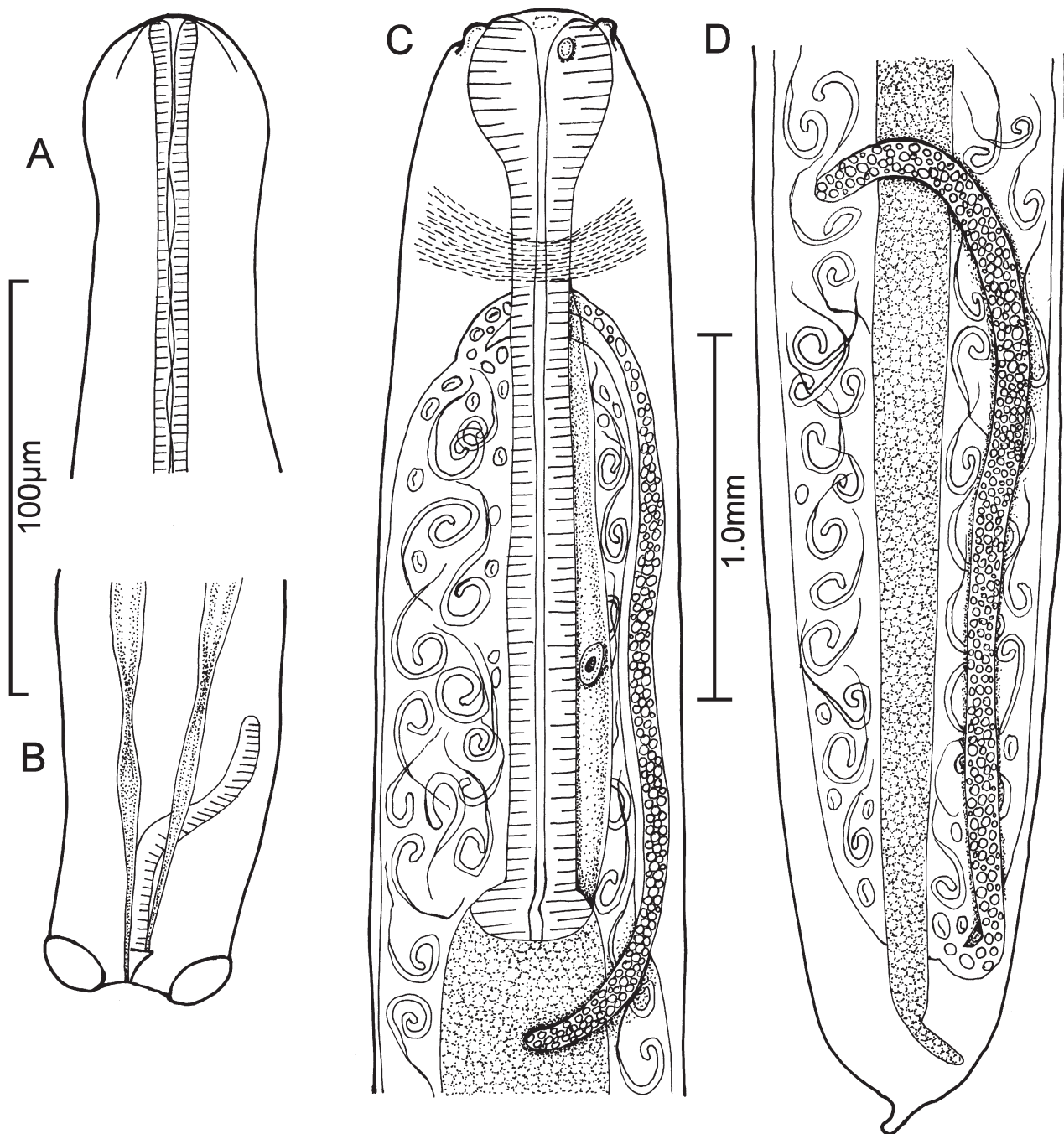


FIGURE 32. *Philometra kobuleji* Molnar & Fernando, 1975. A. male, anterior end; B. male, posterior end; C. female, anterior end; D. female, posterior end. (Redrawn from Molnar & Fernando 1975b)

Females: mature specimens red in colour, 86–97 (91) long. Body cylindrical, tapering at anterior and posterior ends. Cuticle smooth and thin. Body cavity dominated by uterus packed with larvae, 0.320–0.370 (0.350) long; larvae have rounded anterior end and sharply pointed tail (Fig. 32C,D). Head rounded, bearing pair of lateral amphids, and four fleshy papillae in submedian line. Rim of mouth with three lips. Tail tapers at tip, bearing small dorsally directed papilla (Fig. 32D). Oesophagus 1.1–1.4 (1.2) long, with bulb near mouth. Oesophageal gland moderately well developed. Nerve ring 0.3 from anterior end (Fig. 32C). Intestine ends blindly near tail tip (Fig. 32D). Vulva atrophied. Two ovaries joined by common uterine duct. Uteri end near nerve ring and anus (Fig. 32C,D).

Sites: body cavity, mesenteries, swim bladder

Host: *Catostomus commersonii*

Distribution: Ontario

Records: Molnar & Fernando 1975b; Chan 1980; Molnar *et al.* 1982

***Philometra rubra* (Leidy, 1856)**

Synonym: *Filaria rubra* Leidy, 1856

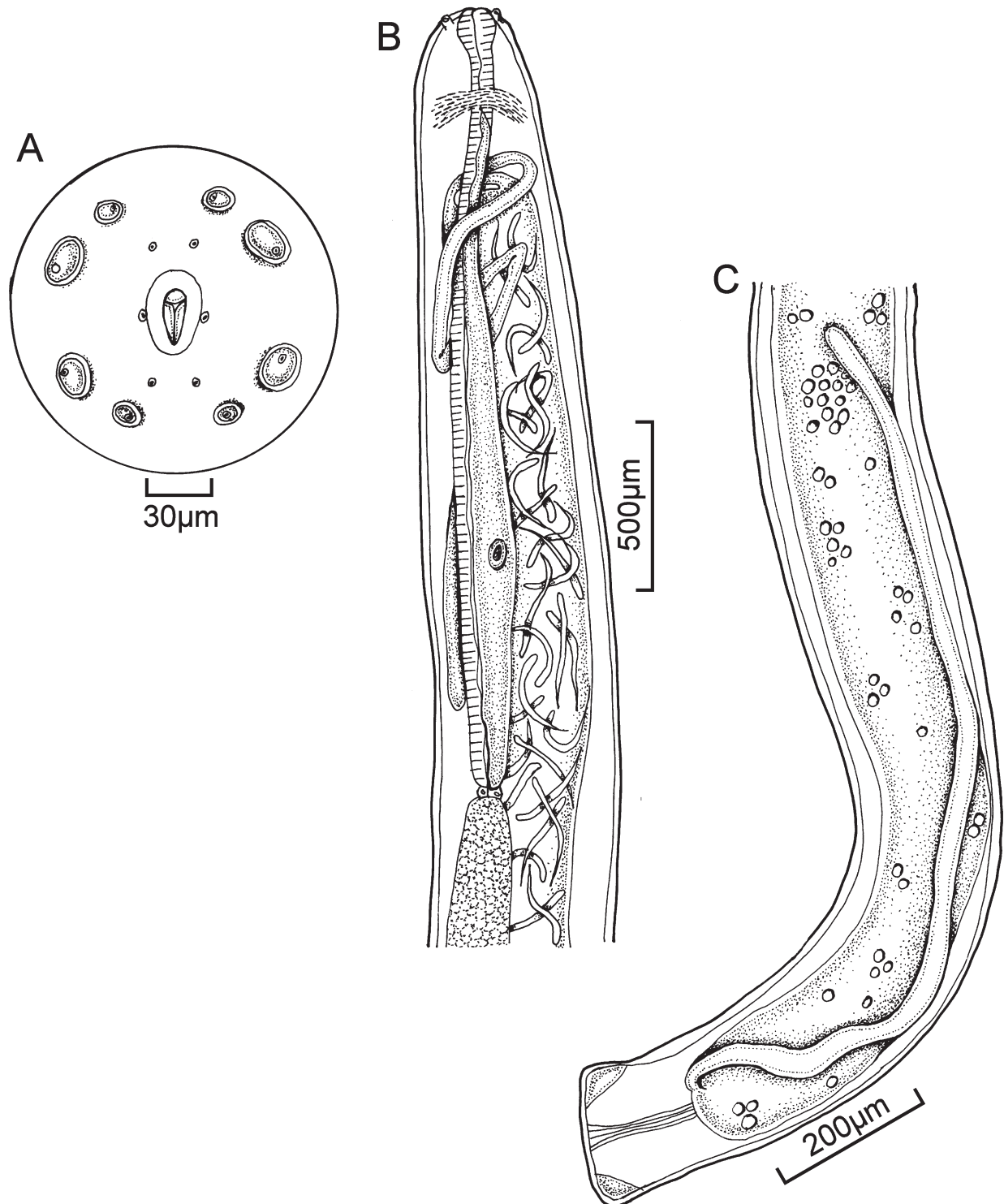


FIGURE 33. *Philometra rubra* (Leidy, 1856): gravid females. A. *en face* view; B. anterior end, lateral view; C. posterior end, dorso-ventral view. (Redrawn from Moravec *et al.* 2013)

Description (after Moravec *et al.* 2009a, and Moravec *et al.* 2013). With characteristics of the genus.

Males unknown.

Females: two gravid worms (measurements of four subgravid worms in parentheses) (after Moravec *et al.* 2013): body 108–184 (100–148) long. Maximum width 0.64–0.79 (0.64–0.68). Head end round, mouth opening small, dorso-ventrally elongate, surrounded by 14 cephalic papillae arranged in two circles, with lateral amphids. Four dorso-lateral and ventro-lateral papillae of outer circle large, dome shaped; four dorso-dorsal and ventro-ventral external papillae small; internal circle comprises one pair of minute lateral papillae and two pairs of minute sub-median papillae (Fig. 33A). Oesophagus 2.6–3.4 long (2.3–4.6). Well developed anterior muscular bulb, and oesophageal gland with large cell nucleus. Nerve ring 0.33–0.39 (0.27–0.53) from anterior end, small ventriculus, oesophagus opens into intestine through distinct valve (Fig. 33B). Intestine brown, ends blindly, attached by ligament to body wall near tail end (Fig. 33C). Vulva and anus absent. Ovaries long, narrow, amphidelphic, situated near anterior end (Fig. 33A) and posterior end (Fig. 33C). Uterus occupies most of body space, filled with 1st-stage larvae, 0.46–0.53 long (Fig. 33B), and eggs (Fig. 33C). Tail end of adults round in lateral view (Fig. 33D) and rectangular in dorso-ventral view (Fig. 33C), bearing two large papilla-like projections (Fig. 33C).

Two subgravid worms (after Moravec *et al.* 2009a): body filiform, 40 and 59 long. Maximum width 0.48 and 0.50. Arrangement of head papillae and alimentary tract anatomy similar to that of gravid worms. Ovaries narrow, long, amphidelphic. Uterus filled with clusters of small spherical eggs.

Comment: the species identified by Séguin *et al.* (2011) as *Philometra* sp. from wild-hatched captive-raised *Morone saxatilis* in Canada probably represents *P. rubra*.

Sites: body cavity, mesenteries

Host: *Morone saxatilis*

Distribution: New Brunswick, Quebec

Records: 1. Hogans 1984 (NB); 2. Moravec *et al.* 2013 (NB, QC)

*****Philometra* sp.**

Sites: body cavity, circulatory system, eye, gills, intestine

Hosts: *Aplodinotus grunniens* (7, 13); *Aulorhynchus flavidus* (5); *Catostomus catostomus* (9); *Catostomus commersonii* (10, 11, 14); *Coregonus artedii* (3, 4); *Coregonus clupeaformis* (3, 4); *Esox niger* (2); *Hypentelium nigricans* (11); *Lepomis gibbosus* (1); *Micropterus dolomieu* (8); *Micropterus salmoides* (12); *Morone saxatilis* (15); *Osmerus mordax* (4); *Perca flavescens* (2, 7, 8); *Pholis laeta* (5); *Platichthys stellatus* (5, 6); *Prosopium cylindraceum* (3, 4, 14); *Salvelinus fontinalis* (2)

Distribution: Ontario, New Brunswick, Pacific, Quebec

Records: 1. Bangham 1941 (ON); 2. Fantham & Porter 1948 (QC); 3. Bangham 1951 (ON); 4. Bangham 1955 (ON); 5. Arai 1967a (PA); 6. Arai 1969 (PA); 7. Dechtiar 1972a (ON); 8. Dechtiar 1972b (ON); 9. Hanek & Molnar 1974 (QC); 10. Molnar *et al.* 1974 (ON); 11. Mackie *et al.* 1983 (ON); 12. Dechtiar & Christie 1988 (ON); 13. Dechtiar & Nepszy 1988 (ON); 14. Dechtiar *et al.* 1989 (ON); 15. Séguin *et al.* 2011 (NB, QC)

***Philometroides* Yamaguti, 1935**

Generic diagnosis (after Moravec 2013). Philometridae. Females much larger than males. Body cylindrical, long. Cuticle of females and males of some species covered with numerous bosses. Cephalic papillae present. Oesophagus short, cylindrical, expanded at anterior end; oesophageal gland usually well developed, mono- or multinucleate; small ventriculus present or absent. Vulva and anus atrophied in gravid worms. Ovaries amphidelphic. Viviparous. Male tail blunt or rounded with or without lobes. Two spicules and gubernaculum present. Parasitic in body cavity and tissues of fresh-water and marine fishes.

Key to species of *Philometroides*

- 1 Caudal, ventro-lateral, hypodermal extensions present; cuticle of both males and females covered with bosses; worms occur mainly in pectoral fins and occasionally in pelvic, dorsal and anal fins. *P. huronensis*

- Caudal hypodermal extensions absent; bosses absent from cuticle of males; worms occur mainly in subcutaneous tissues of head *P. nodulosus*

***Philometroides huronensis* Uhazy, 1976**

Description (after Uhazy 1976). With characteristics of the genus. Body cylindrical with bluntly narrowing

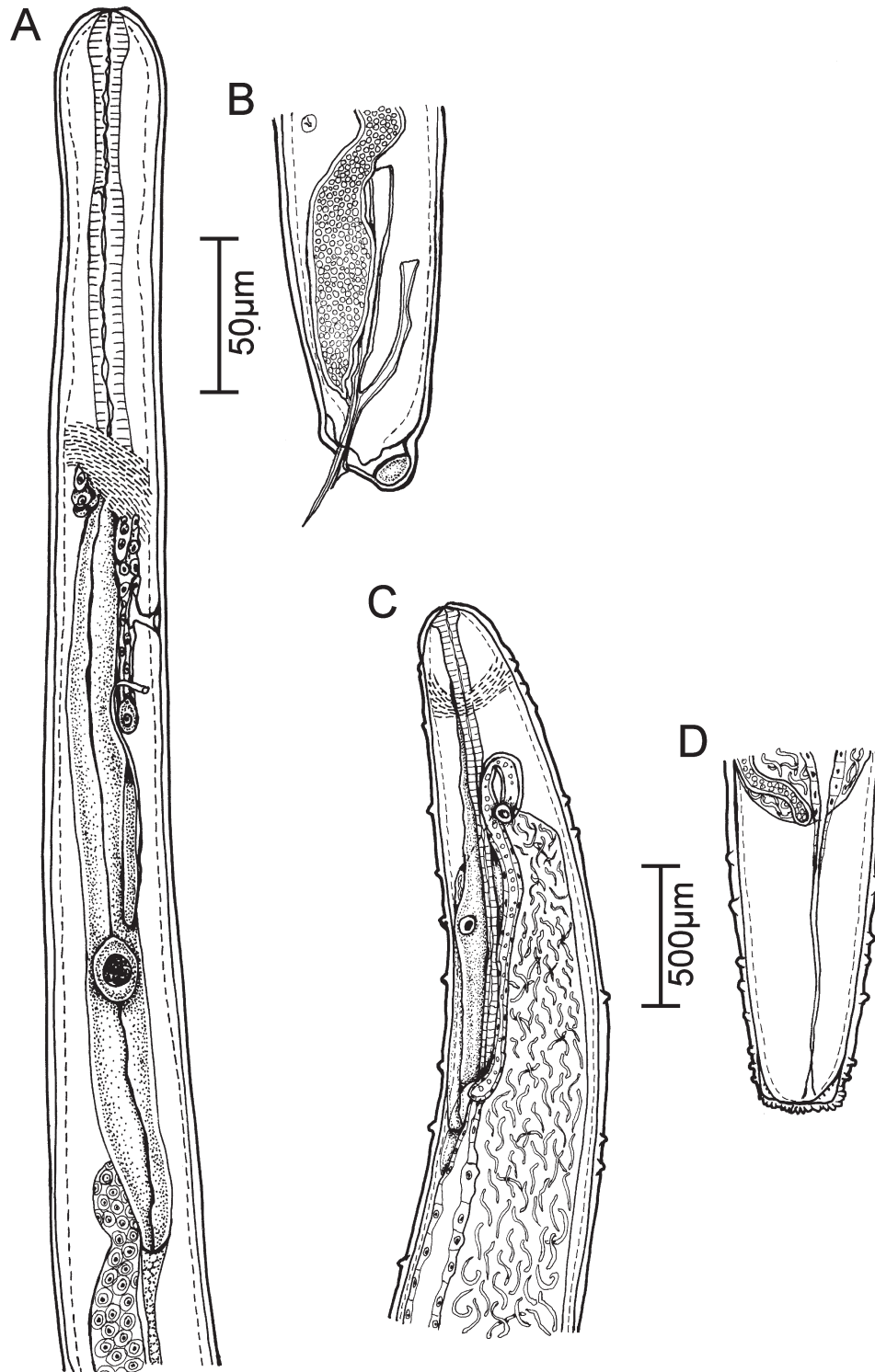


FIGURE 34. *Philometroides huronensis* Uhazy, 1976. A. male, anterior region, ventro-lateral view; B. male, posterior region, lateral view; C. gravid female, anterior region, lateral view; D. gravid female, posterior region, ventral view. (Redrawn from Uhazy 1976)

extremities. Cuticle longitudinally striated with numerous irregularly distributed bosses. Mouth opening surrounded by three lips. Cephalic papillae comprise six inner and four pairs outer papillae. Amphids distinct. Oesophagus inflated anteriorly with a short anterior muscular portion and longer posterior glandular portion. Dorsal oesophageal gland prominent. Nerve ring at posterior end of muscular oesophagus (Fig. 34A).

Mature males: 2.8–3.6 long, and 0.041–0.05 wide. Muscular oesophagus 0.159–0.245 and glandular oesophagus 0.214–0.398 long. Dorsal oesophageal gland large with distinct nucleus (Fig. 34A). Nerve ring 0.128–0.191, hemizonid 0.150–0.309, excretory pore 0.167–0.301, right anterior deirid 0.180–0.355, and left anterior deirid 0.197–0.356 from anterior end. Right posterior deirid 0.139–0.272, and left posterior deirid 0.310–0.513 from posterior end. Intestine ligament-like throughout its length. Monorchic testis at level of oesophago-intestinal junction. *Vas deferens* and ejaculatory duct packed with spermatozoa. Spicules slender, unequal: right one 0.122–0.140, left one 0.110–0.134, and gubernaculum 0.070–0.082 long. Anus subterminal. Caudal extremity distinctly lobed, with one pair pre-cloacal and two pairs post-cloacal papillae (Fig. 34B). Phasmids terminal. Cuticle longitudinally striated and covered with minute bosses.

Gravid females: 35.4–101.0 long, and 0.600–0.850 wide. Muscular oesophagus 0.29–0.48 and glandular oesophagus 1.0–1.9 long. Dorsal oesophageal gland large with distinct nucleus (Fig. 34C). Nerve ring 0.270–0.440 from anterior end. Uterus 34.0–98.8 long. Intestine ligamentous posteriorly; anus not patent. Caudal papillae absent. Prominent hypodermis giving rise to caudal, ventro-lateral extensions (Fig. 34D). Cuticular bosses distributed generally on body but clustered in regions of caudal hypodermal extensions (Fig. 34D). Amphidelphic, didelphic, uterus thin walled and packed with 1st-stage larvae 0.362–0.406 long. 97% of body length occupied by uterus (Fig. 34C,D). Ovaries often reflexed and close to anterior and posterior ends of body. Vulva and vagina absent (Fig. 34C,D).

Comments: Uhazy (1976) also provided measurements of subgravid and mature females.

Sites: fins, mesenteries, swim bladder, subcutaneous

Hosts: *Catostomus catostomus* (4, 5, 7, 10); *Catostomus commersonii* (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12); *Catostomus macrocheilus* (7, 10); *Moxostoma macrolepidotum* (4, 5)

Distribution: British Columbia, Manitoba, Ontario, Quebec

Records: 1. Uhazy 1976 (ON); 2. Uhazy & Anderson 1976 (ON); 3. Uhazy 1977a (ON); 4. Uhazy 1977b (ON); 5. Uhazy 1977c (ON); 6. Uhazy 1978 (ON); 7. Anon. 1978 (BC); 8. Chan 1980 (ON); 9. Molnar *et al.* 1982 (ON); 10. Arai & Mudry 1983 (BC); 11. Mackie *et al.* 1983 (ON); 12. Dubois *et al.* 1996 (QC)

***Philometroides nodulosus* (Thomas, 1929) Dailey, 1967**

Synonym: *Philometra nodulosa* Thomas, 1929

Description (after Dailey 1966). With characteristics of the genus.

Males (five studied): cuticle smooth, lacking bosses. Body uniform in width except for anterior tapering, 2.39–2.68 long, and 0.031–0.048 wide. Mouth small with three unelevated lips; inner ring of four papillae and outer ring of four pairs of papillae, and pair of amphids (Fig. 35A). Oesophagus 0.623–0.688 long. Oesophageal gland 0.414 long with large nucleus. Nerve ring just behind anterior oesophageal swelling. Posterior end truncated with two ventral and two dorsal rounded swellings. Anus median. Spicules subequal, left one 0.137–0.164 and right one 0.130–0.161 long. Gubernaculum 0.048–0.059 long with terminal barb (Fig. 35B). Seminal vesicle begins just behind oesophageal gland, extending posteriorly 1.46, and ending in slender *vas deferens* that leads to posterior end.

Females (five gravid and 20 subgravid worms studied): cuticle covered with numerous irregularly spaced, rounded bosses confined to the cortical layer. Body of uniform width except at anterior and posterior ends where it tapers slightly, 30.0–44.5 long and 0.370–0.602 wide. Mouth with three elevated fleshy lips, an inner ring of four and an outer ring of eight evenly spaced papillae, and a pair of amphids (Fig. 35C). Oesophagus 1.91–3.1 long. Small ventriculus with four appendices projecting into intestine. Oesophageal gland with large nucleus (Fig. 35D). Anus absent, intestine ending blindly near bluntly rounded posterior end. Anterior ovary loops over oesophagus and extends caudad; posterior ovary doubles back on itself to project anteriad (Fig. 35E). Ovaries lead into uterus (Fig. 35D,E). Uterus a single, blind tubule packed with ova containing developing 1st-stage larvae that occupy most of body-cavity.

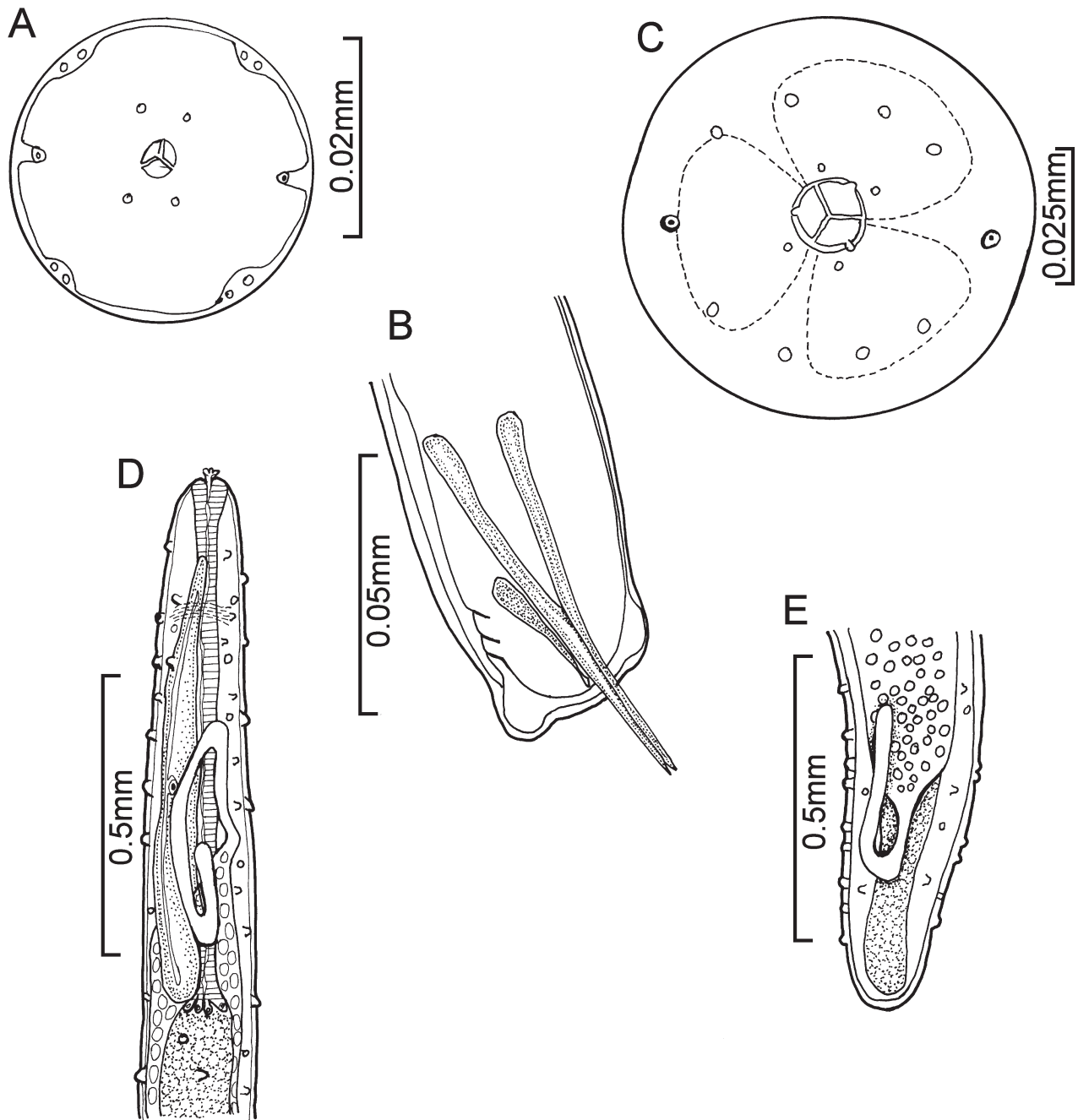


FIGURE 35. *Philometroides nodulosus* (Thomas, 1929) Dailey, 1967. A. adult male, *en face* view; B. adult male, posterior end, lateral view; C. adult female, *en face* view; D. adult female, anterior end, lateral view; E. adult female, posterior end, lateral view. (Redrawn from Dailey 1966)

Comments: Dailey (1966) is an unpublished PhD thesis in which it is claimed that males of *Philometroides nodulosus* were described for the first time. Dailey (1967) presumably refers to an abstract of that thesis in which the n. comb. was first widely publicised. Dailey (1967) has not been traced, and does not appear in the reference list of this part of the Guide therefore. Adding to the confusion, there appear to be discrepancies in the measurements provided in the foregoing description of *P. nodulosus* and the illustrations (see Figure 35). A redescription of *P. nodulosus* is justified.

Sites: cheek galleries, eye, gills, subcutaneous

Hosts: *Carpiodes cyprinus* (2, 6); *Catostomus catostomus* (7); *Catostomus commersonii* (1, 3, 4, 5, 6, 7, 8, 9, 10, 11)

Distribution: Manitoba, Ontario, Quebec

Records: 1. Fantham & Porter 1948 (QC); 2. Dechtiar 1972b (ON); 3. Chan 1980 (ON); 4. Molnar *et al.* 1982 (ON); 5. Dechtiar & Christie 1988 (ON); 6. Dechtiar & Nepszy 1988 (ON); 7. Dechtiar *et al.* 1988 (ON); 8. Dechtiar *et al.* 1989 (ON); 9. Szalai 1989 (MB); 10. Szalai *et al.* 1992 (MB); 11. Dubois *et al.* 1996 (QC)

****Philometroides* sp.**

Site: eye

Host: *Catostomus commersonii*

Distribution: Ontario

Record: Chan 1980

***Philonema* Kuitunen-Ekbaum, 1933**

Generic diagnosis (after Moravec 2013). Philometridae. Body thread-like, anterior end rounded, posterior end conical. Cuticle smooth. Cephalic papillae present or absent. Oesophagus short, posterior half expanded and containing multinucleate oesophageal gland. Females very much larger than males. Male tail coiled; cloaca remote from tail tip. Spicules simple, equal. Gubernaculum absent. Vulva and anus of gravid worms atrophied. Ovaries amphidelphic. Viviparous. Parasitic in body cavity and tissues of fishes.

Comments: Adamson *et al.* (1992) distinguished *Philonema agubernaculum* from *Oncorhynchus mykiss* and *P. oncorhynchi* from *O. nerka* on the basis of DNA restriction fragment length differences but did not provide morphological details. According to Moravec & Nagasawa (1999) the three recognized species of *Philonema* from salmonids (*P. agubernaculum*, *P. oncorhynchi* and *P. sibirica*) are inadequately described, especially regarding male caudal morphology, and cannot be distinguished one from another on the basis of the morphological features given in existing descriptions. For these reasons a key to distinguish *P. agubernaculum* from *P. oncorhynchi* has not been attempted here.

*****Philonema agubernaculum* Simon & Simon, 1936**

Synonym: ***Philonema salvelini* Richardson, 1936

Description (after Simon & Simon 1936). With characteristics of the genus.

Males: mean 16.5 (range 12–23) long; mean maximum width 0.296. Mean lengths of the muscular and glandular portions of the oesophagus are 0.404 and 1.122 respectively. Anus to tail tip averages 0.276. Spicules equal, sharply curved, lightly chitinized, mean length 0.284 (Fig. 36A).

Females: 86.1 (49–140) long; mean maximum width 0.771. Mean lengths of muscular and glandular oesophagus 0.553 and 1.172 respectively (Fig. 36B). Anus to tail tip averages 0.446 (Fig. 36C). Anus sometimes atrophied in gravid worms. Vulva and vagina atrophied in gravid worms. Small ovary present at each end of body. Uterus of gravid worms filled with embryos and occupying nearly all of the body cavity. Uteri of young specimens contains eggs in various stages of development. Eggs measure 0.032 x 0.046. Embryos 0.343 long.

Comments: ***P. agubernaculum* requires both redescription and much improved illustrations. A nerve ring is not mentioned in the original description so in Figure 36B one has been added in a position based on the anatomy of ***P. oncorhynchi* (see Fig. 37B,D).

Sites: body cavity, kidneys, liver, swim bladder

Hosts: *Coregonus artedii* (11, 15); *Coregonus clupeaformis* (6, 21); *Gasterosteus aculeatus* (8); *Oncorhynchus kisutch* (9, 11, 15, 33); *Oncorhynchus mykiss* (4, 7, 12, 14, 19, 21, 33); *Oncorhynchus nerka* (14, 21, 24, 26, 27, 29, 32, 36); *Osmerus mordax* (8); *Prosopium cylindraceum* (6); *Prosopium williamsoni* (12, 14, 19, 21, 35); *Salmo salar* (31); *Salvelinus alpinus* (5, 6, 10, 13, 16, 17, 18, 20, 22, 23, 25, 28, 34, 37); *Salvelinus fontinalis* (1, 2, 3, 6, 8, 30, 31); *Salvelinus malma* (14, 21); *Salvelinus namaycush* (6, 20, 21)

Distribution: Alberta, British Columbia, Labrador, Newfoundland, Northwest Territories, Pacific, Quebec

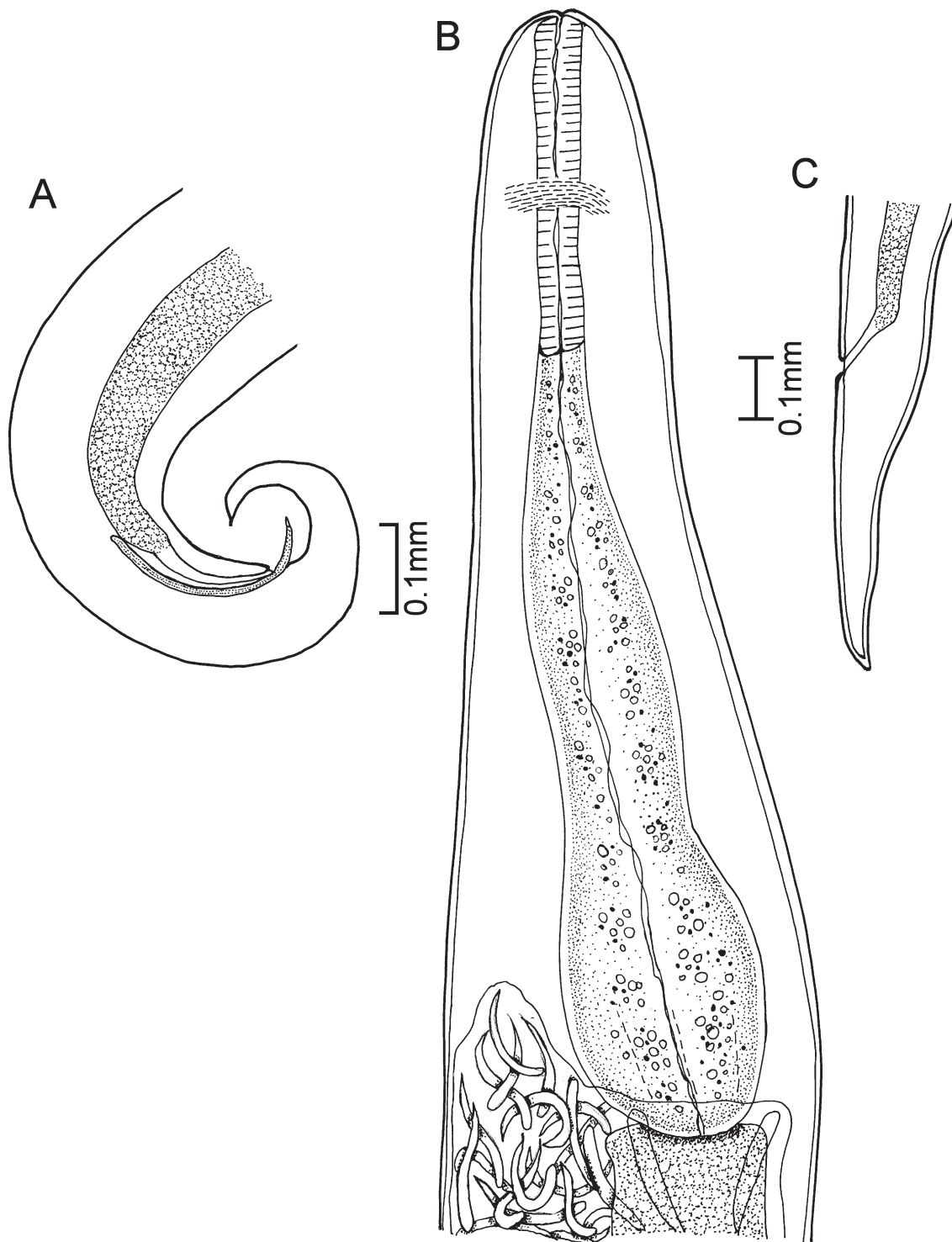


FIGURE 36. *Philonema agubernaculum* Simon & Simon, 1936. A. male, posterior end; B. female, anterior end; C. female, posterior end. (Redrawn from Simon & Simon 1936 but with the addition in B. of a nerve ring)

Records: 1. Richardson 1936a (QC); 2. Richardson 1936b (QC); 3. Sandeman & Pippy 1967 (NF); 4. Ko & Adams 1969 (BC); 5. Pippy 1970 (NF); 6. Hicks & Threlfall 1973 (LB); 7. Adams 1974 (EX, BC); 8. Hanek & Molnar 1974 (QC); 9. Leong & Holmes 1974 (AB); 10. Jamieson & Freeman 1975 (NT); 11. Leong 1975 (AB); 12. Anon. 1978 (BC); 13. Curtis 1979 (NU); 14. Anon. 1981 (BC); 15. Leong & Holmes 1981 (AB); 16. Dick & Belosevic 1981 (NT); 17. Curtis 1982 (NT); 18. Stewart & Bernier 1982 (NU); 19. Arai & Mudry 1983 (BC); 20. Stewart & Bernier 1983 (NT); 21. Anon. 1984 (BC); 22. Curtis 1984 (NT, QC); 23. Dick 1984 (NT);

24. Groot *et al.* 1984 (BC); 25. Stewart & Bernier 1984 (NT); 26. Bailey & Margolis 1987 (BC); 27. Bailey *et al.* 1988 (BC); 28. Bouillon & Dempson 1989 (LB); 29. Groot *et al.* 1989 (BC); 30. Marcogliese & Cone 1991a (LB, NL); 31. Marcogliese & Cone 1991b (NF); 32. Adamson *et al.* 1992 (BC); 33. Despres *et al.* 1995 (BC); 34. Kolasa & Curtis 1995 (QC); 35. Nener *et al.* 1995 (BC); 36. Bennett *et al.* 1998 (BC); 37. Desdevises *et al.* 1998 (QC)

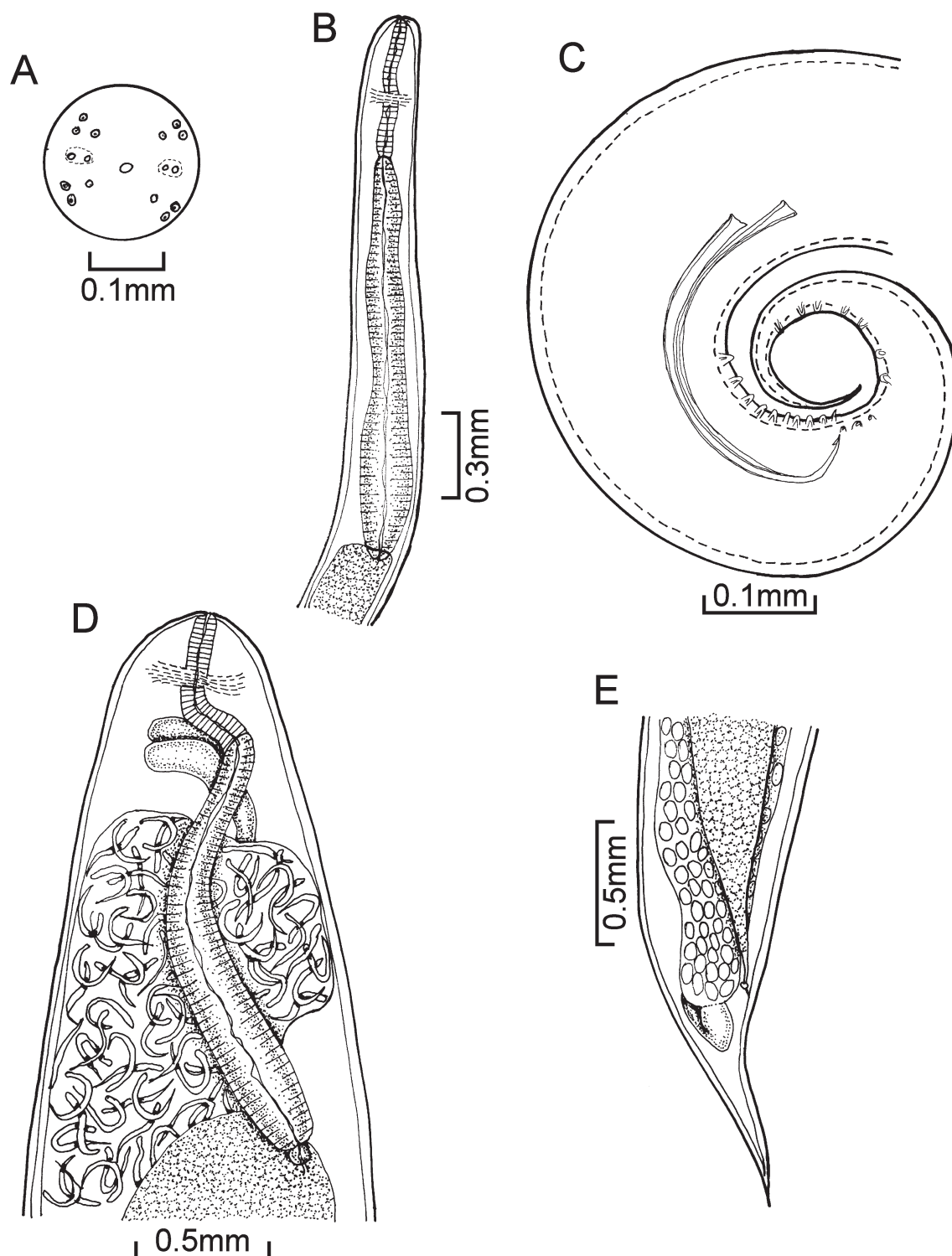


FIGURE 37. *Philonema oncorhynchi* Kuitunen-Ekbaum, 1933. A. female, *en face* view; B. male, anterior end, lateral view; C. male, posterior end, lateral view; D. gravid female, anterior end, with larvae in uterus; E. subgravid female, posterior end, with eggs in uterus. (Redrawn from Moravec & Nagasawa 1999a)

*****Philonema oncorhynchi* Kuitunen-Ekbaum, 1933**

Description (after Moravec & Nagasawa 1999a). With characteristics of the genus. Body filiform, whitish in colour, cuticle smooth. Head end rounded, bearing two rings of small papillae: outer ring of four pairs of papillae, inner ring with four single papillae. Small lateral bifid amphids present (Fig. 37A). Mouth opening circular. Oesophagus comprises short and narrow anterior muscular portion, and longer and wider posterior glandular portion. Oesophagus enters intestine through valve. Intestine light coloured, relatively wide anterior end. Tail conical ending in sharp point.

Males: body 13.91–30.16 long, and 0.206–0.412 wide. Muscular oesophagus 0.444–0.762, and glandular portion 1.218–2.162 long. Nerve ring 0.261–0.391 from anterior end (Fig. 37B). Excretory pore not seen. Caudal end ventrally curved. Tail 0.331–0.566 long. Spicules equal, simple, needle-like, well sclerotized, 0.188–0.396 long. Pre-cloacal papillae: nine pairs small sessile subventral papillae, plus two subventral horn-like outgrowths or papillae separated by one unpaired median papilla on anterior cloacal lip. Post-cloacal papillae: nine pairs of small subventral papillae, distance between 2nd and 3rd greater than that between 3rd and 4th pairs (Fig. 37C).

Females (gravid worms with larvae): body 102.8–185.0 long, and 0.948–1.483 wide. Head end rounded, cephalic papillae indistinct in lateral view. Muscular oesophagus 0.433–1.092, and glandular portion 1.277–2.019 long. Nerve ring 0.252–0.453 from anterior end (Fig. 37D). Excretory pore not seen. Anal opening absent. Vulva and vagina atrophied. Uterus amphidelphic, occupying most of body space, containing many 1st-stage larvae; it extends anteriorly to oesophagus level (Fig. 37D), and posteriorly a little behind end of intestine (Fig. 37E). Anterior and posterior ovaries reflexed, relatively short (Fig. 37D,E).

Larvae from uterus variable in shape and size, 0.392–0.580 long, 0.020–0.028 wide. Head end with small dorsal tooth. Tail sharply pointed (Fig. 37E).

Sites: body cavity, mesenteries, swim bladder

Hosts: *Carassius auratus* (25); *Oncorhynchus clarkii* (6); *Oncorhynchus gorbuscha* (9, 31); *Oncorhynchus kisutch* (6); *Oncorhynchus mykiss* (6, 16, 25); *Oncorhynchus nerka* (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19, 20, 21, 22, 25, 26, 27, 28, 29, 30, 32, 33, 34, 35); *Oncorhynchus tshawytscha* (5, 23, 24); *Salvelinus malma* (6)

Distribution: British Columbia, Ontario, Pacific

Records: 1. Kuitunen-Ekbaum 1933a (PA); 2. Kuitunen-Ekbaum 1933b (PA); 3. Smedley 1933 (BC); 4. Kuitunen-Ekbaum 1937a (BC); 5. Margolis 1952b (PA); 6. Bangham & Adams 1954 (BC); 7. Dombrowski 1955 (BC); 8. Margolis 1956 (BC, PA); 9. Margolis 1957 (BC, PA); 10. Margolis 1963 (BC, PA); 11. Bashirullah & Adams 1966 (BC); 12. Platzer 1966 (BC); 13. Platzer & Adams 1967 (BC); 14. Ko & Adams 1969 (BC); 15. Adams 1969 (EX, BC); 16. Bell & Hoskins 1971 (BC); 17. Lewis 1973 (BC); 18. H. D. Smith 1973 (BC); 19. Adams 1974 (BC); 20. Lewis *et al.* 1974 (BC); 21. Bell & Margolis 1976 (BC); 22. Boyce & Yamada 1977 (BC); 23. Anon. 1978 (BC); 24. Arai & Mudry 1983 (BC); 25. Bashirullah 1983 (EX, BC); 26. Bashirullah & Adams 1983 (BC); 27. Groot *et al.* 1984 (BC); 28. Bailey & Margolis 1987 ((BC); 29. Wood *et al.* 1987 (BC); 30. Bailey *et al.* 1988 (BC); 31. Dechtiar & Lawrie 1988 (ON); 32. Groot *et al.* 1989 (BC); 33. Garnick & Margolis 1990 (BC); 34. Adamson *et al.* 1992 (BC); 35. Després *et al.* 1995 (BC)

*****Philonema* sp.**

Sites: body cavity, peritoneum, stomach, testes

Hosts: *Acrocheilus alutaceus* (6); *Catostomus commersonii* (17); *Coregonus artedii* (2, 19); *Coregonus clupeaformis* (15, 16); *Coregonus* sp. (5); *Esox lucius* (5); *Oncorhynchus clarkii* (14); *Oncorhynchus kisutch* (12, 13); *Oncorhynchus mykiss* (15, 16, 18); *Oncorhynchus nerka* (10, 11, 15, 16, 20); *Oncorhynchus tshawytscha* (12, 13); *Prosopium cylindraceum* (6); *Prosopium williamsoni* (6, 11, 15, 16); *Salvelinus alpinus* (7, 8); *Salvelinus fontinalis* (4, 9); *Salvelinus malma* (15, 16); *Salvelinus namaycush* (1, 2, 3, 5); *Thymallus arcticus* (15, 16)

Distribution: Alberta, Labrador, Manitoba, Northwest Territories, Ontario, Pacific, Quebec

Records: 1. MacLulich 1943 (ON); 2. Miller 1945 (AB, NT); 3. Miller & Kennedy 1948 (NT); 4. Munroe 1949 (LB, QC); 5. Rawson 1951 (NT); 6. Bangham & Adams 1954 (BC); 7. Andrews & Lear 1956 (LB); 8.

Thomson 1957 (NT); 9. Pippy 1965 (NF); 10. Wood 1965 (BC); 11. Meredith 1966 (BC); 12. Arai 1967a (PA); 13. Arai 1969 (PA); 14. Hoskins *et al.* 1976 (BC); 15. Anon. 1978 (BC); 16. Arai & Mudry 1983 (BC); 17. Poole 1983 (MB); 18. Margolis 1984 (PA); 19. Nelson & Paetz 1992 (AB); 20. Després *et al.* 1995 (BC)

Philometridae gen. sp.

Sites: musculature, subcutaneous

Hosts: *Gobiesox maeandricus*; *Platichthys stellatus*; *Paraplagusia bilineata*; *Rhodymenichthys dolichogaster*

Distribution: Pacific

Record: Kuitunen-Ekbaum 1933a

Comment: Kuitunen-Ekbaum (1933a) reported “*Philometra sanguinea*” from the four species listed above, the fishes having been caught in Departure Bay, BC. The identification cannot be confirmed in the absence of a description or illustration. In any event, Rasheed (1963) referred this philometrid species to the genus *Philometroides*. Moravec (2013), for example, described and illustrated *Philometroides sanguineus* from *Carassius* spp., these hosts being fresh-water cyprinids, rather than species of marine fishes. For these reasons it is best to list the record merely as a philometrid.

Superfamily GNATHOSTOMATOIDEA Railliet, 1895

Family GNATHOSTOMATIDAE Railliet, 1895

****Spiroxys contortus* (Rudolphi, 1819) Schneider, 1866**

Preamble: Because an account of L3 from fishes does not appear to be available, Bartlett & Anderson’s (1985) description of specimens from snails *Lymnaea stagnalis* is given here.

L3 variable in length: short ones 1.8 (1.6–2.0); longer ones—on which the remainder of the description is based—2.7 (2.5–2.9) long. Maximum width 0.064 (0.058–0.070). Anterior end with two pseudolabia, eight cephalic papillae, and two lateral amphids. Cuticle thick, with fine transverse striations. Nerve ring 0.155 (0.140–0.160) and excretory pore 0.200 (0.190–0.220) from anterior end. Deirids 0.080 (0.065–0.095) behind excretory pore. Buccal cavity 0.019 (0.016–0.020) long. Oesophagus 0.90 (0.78–1.09) long, and divided near nerve ring into anterior muscular and posterior glandular portions (Fig. 38A). Genital primordium oval, 1.8 (1.6–2.1) from anterior end. One post-deirid present near genital primordium. Anus 0.078 (0.070–0.090) from posterior extremity. Phasmids large, protuberant. Tail tapers to point (Fig. 38B).

Site: mesenteries

Hosts: *Ameiurus nebulosus*; *Perca flavescens*

Distribution: Ontario

Record: Molnar *et al.* 1974

****Spiroxys* sp.**

Sites: alimentary tract, mesenteries, viscera

Hosts: *Ambloplites rupestris* (9); *Ameiurus nebulosus* (9); *Catostomus commersonii* (5); *Catostomus macrocheilus* (3); *Culaea inconstans* (13); *Etheostoma nigrum* (2, 4); *Fundulus diaphanus* (6); *Lepisosteus osseus* (9); *Lepomis gibbosus* (3, 7); *Luxilus cornutus* (13); *Micropterus dolomieu* (11); *Morone chrysops* (11); *Notropis heterolepis* (2, 12); *Notropis hudsonius* (4); *Perca flavescens* (2, 4, 8); *Phoxinus neogaeus* (13); *Pimephales notatus* (2); *Ptychocheilus oregonensis* (3); *Rhinichthys cataractae* (10); *Richardsonius balteatus* (3); *Semotilus atromaculatus* (13); *Umbra limi* (1, 9, 12)

Distribution: British Columbia, Nova Scotia, Ontario

Records: 1. Bangham & Hunter 1939 (ON); 2. Bangham 1951 (ON); 3. Bangham & Adams 1954 (BC); 4.

Bangham 1955 (ON); 5. Dechtiar 1972a; 6. Wiles 1975 (NS); 7. Cone & Anderson 1977 (ON); 8. Baker 1984b (ON); 9. Dechtiar & Christie 1988 (ON); 10. Dechtiar & Lawrie 1988 (ON); 11. Dechtiar & Nepszy 1988 (ON); 12. Dechtiar *et al.* 1988 (ON); 13. Dechtiar *et al.* 1989 (ON)

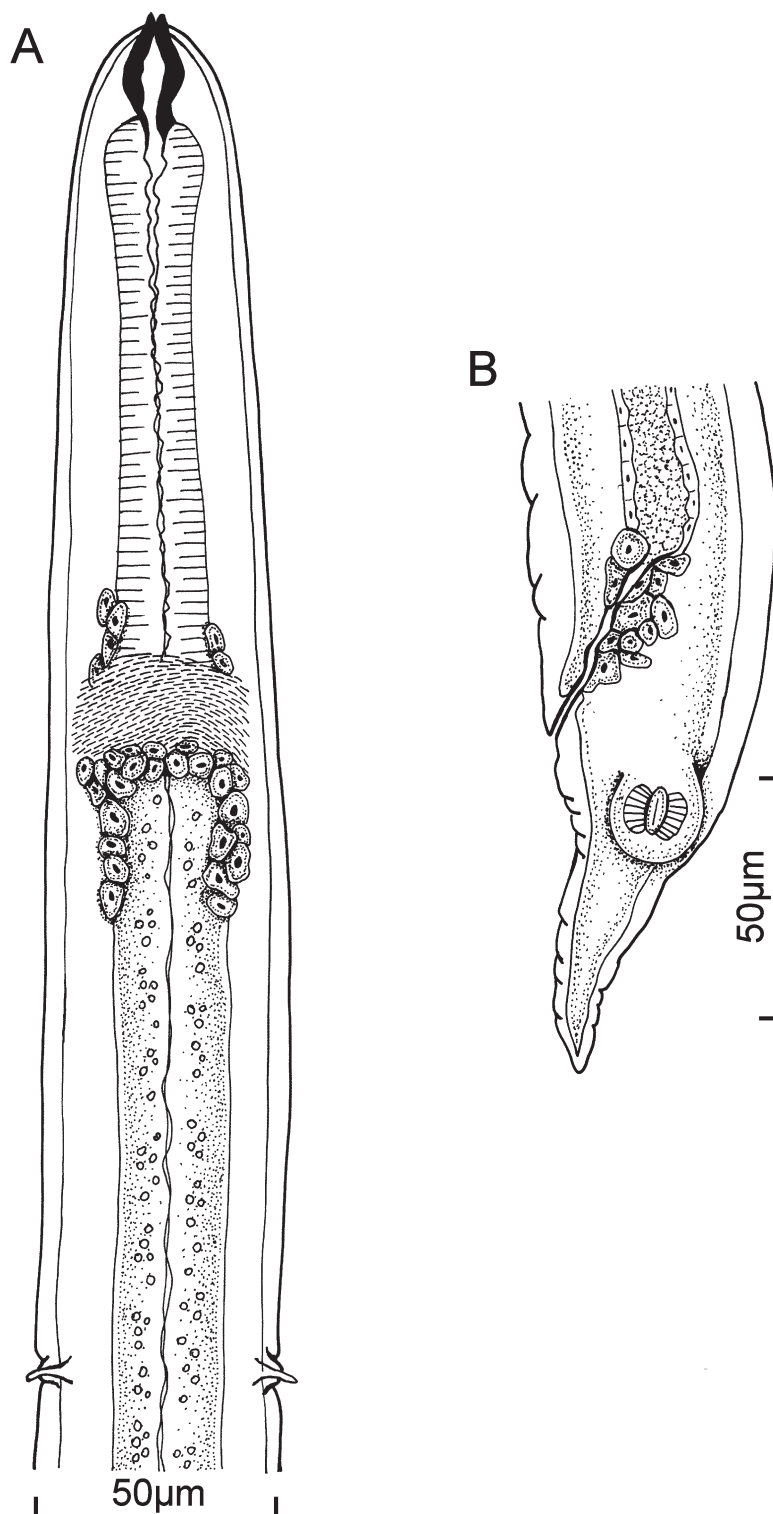


FIGURE 38. **Spiroxys contortus* (Rudolphi, 1819) Schneider, 1866. A. anterior end, dorso-ventral view; B. posterior end, lateral view. (Redrawn from Bartlett & Anderson 1985)

Infraorder OXYURIDOMORPHA

Superfamily OXYUROIDEA

There appears to be only one record of a member of this Superfamily in a Canadian species of fish, namely that of Arthur (1978) [repeated by Arthur & Arai 1980a]. No morphological details were provided.

Oxyuroidea gen. sp. larva type 1

Site: gill washings

Host: *Clupea pallasii*

Distribution: Pacific

Records: Arthur 1978; Arthur & Arai 1980a

Superfamily CAMALLANOIDEA Travassos, 1920

Family CAMALLANIDAE Railliet & Henry, 1915

Family diagnosis (after Moravec 2013). Outer circle of cephalic papillae comprising four large and four rudimentary papillae; inner circle formed by six very small papillae. Buccal cavity strongly sclerotized, laterally compressed and forming two sclerotized lateral valves, or rounded. Mouth opening slit-like or rounded. Lips absent or rudimentary. Pseudolabia absent. Oesophagus divided into anterior muscular and posterior glandular sections. Spicules unequal. Gubernaculum present or absent. Vulva near mid-body. Viviparous. Parasites of cold-blooded vertebrates.

Key to genera of CAMALLANIDAE

- | | | |
|---|---|-------------------|
| 1 | Longitudinal bands sustaining the two lateral valves of the divided buccal capsule continuous | <i>Camallanus</i> |
| - | Longitudinal bands sustaining the two lateral valves transformed posteriorly into rows of spines or a few combs | <i>Oncophora</i> |

***Camallanus* Railliet & Henry, 1915**

Generic diagnosis (after Moravec 2013). Camallanidae. Mouth opening slit-like. Buccal capsule divided into two lateral valves; buccal cavity behind valves reduced to basal ring; longitudinal thickenings (bands) sustaining buccal valves continuous, smooth or armed with denticles, not separated into ventral and dorsal groups; tridents present. Usually six to seven pairs of pre-cloacal papillae in males. Spicules unequal. Parasites of alimentary tract of fishes and amphibians.

Key to species of *Camallanus*

- | | | |
|---|--|-----------------------|
| 1 | Head straight, not bent ventrally. Males < 9.0 long, with 11 pairs of pedunculate caudal papillae: six pairs pre-cloacal, five pairs post-cloacal. Female tail > 1.5 long | <i>C. oxycephalus</i> |
| - | Head bent slightly ventrally. Males > 9.0 long, with 11 pairs of pedunculate and two pairs of sessile, caudal papillae: one sessile and seven pedunculate pairs pre-cloacal, one sessile and four pedunculate pairs post-cloacal. Female tail < 0.6 long | <i>C. ancylodirus</i> |

*****Camallanus ancylodirus* Ward & Magath, 1917**

Description (after Baker 1979). With characteristics of the genus. Slender worms with blunt anterior end, and

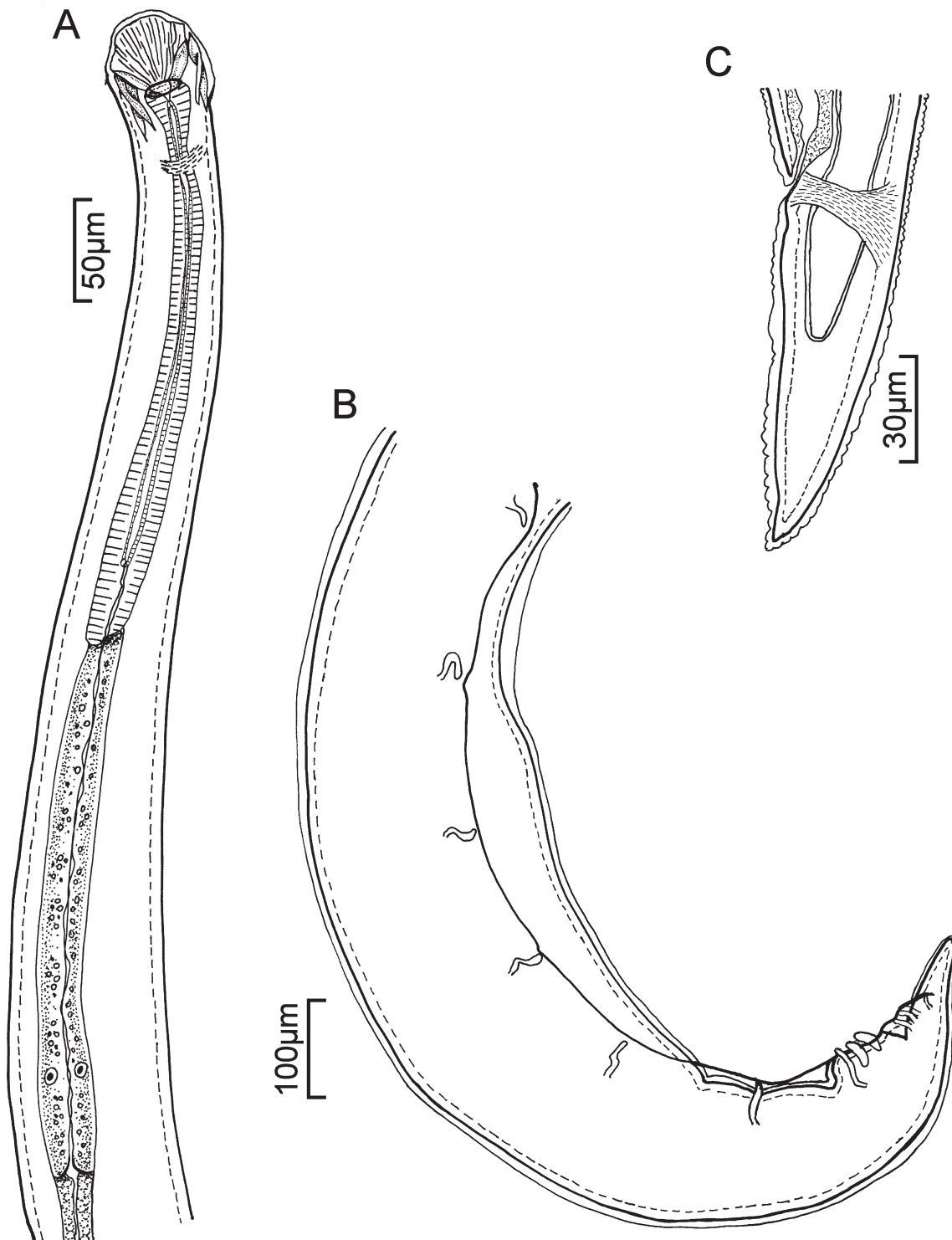


FIGURE 39. *Camallanus ancylodirus* Ward & Magath, 1917. A. female, anterior end, lateral view; B. male, posterior end, lateral view; C. female, posterior end, lateral view. (Redrawn from Baker 1979)

posterior end. Males about two-thirds size of gravid females. Head bent slightly ventrally in mature worms. Cuticle 0.007 thick with faint longitudinal and transverse striations. Mouth opening elongate. Four cephalic papillae observed. Amphids not observed. Buccal capsule with identical lateral valves, each with numerous irregular,

slender, longitudinal ridges. A pair of sclerotized plates near anterior margin of each buccal valve. Posterior end of buccal cavity surrounded by prominent sclerotized ring. Tridents prominent, with pair of elongate, equal, lateral processes and elongate medial process. Oesophagus divided into slender anterior muscular portion and slender posterior glandular portion (Fig. 39A).

Males (two specimens): 15.2 and 17.1 long. Buccal valves 0.137 and 0.39, tridents 0.173 and 0.186, muscular oesophagus 1.08 and 1.15, and glandular oesophagus 0.70 and 1.00 long. Nerve ring 0.318 and 0.346 from anterior end. Posterior end with prominent protuberance in anal region and ventral groove-like constriction in mid-region of tail. Tail 0.138 and 0.157 long, tapering to blunt terminal point. Caudal end with 11 pairs of subventral pedunculate papillae distributed as follows: seven pre-cloacal pairs arranged in two rows with papillae in each row evenly spaced, and four post-cloacal pairs with the three most anterior pairs arising closely together from hypodermis. All pedunculate caudal papillae contained within prominent caudal alae. Hypodermal protuberance in anal region with one pre-cloacal and one post-cloacal pair of sessile papillae. Sessile papillae with band of thick cuticle extending laterally to base of protuberance (Fig. 39B). Spicules prominent, unequal, curved in lateral view, with blunt capitulum and tubular shaft ending distally in sharp point. Right spicule with robust shaft, 0.277–0.290 long; left one relatively slender, 0.218–0.239 long.

Females (four specimens): 24.2–26.2 long. Buccal valves 0.170–0.186, tridents 0.178–0.215, muscular oesophagus 1.16–1.39, and glandular oesophagus 1.31–1.39 long. Nerve ring 0.337–0.361 from anterior end. Vulva small and round, opening into cup-shaped projection of the cuticle, 9.4–11.5 from posterior end. Cuticle beside vulva forming an elongate ridge about 0.250 long. Tail 0.451–0.480 long, tapering to blunt point. Anus inconspicuous. Posterior part of uterus extending behind anus to mid-region of tail (Fig. 39C). Uterus contains numerous larvae.

Site: intestine

Host: *Carpiodes cyprinus*

Distribution: Ontario

Record: Dechtiar & Nepszy 1988

*****Camallanus oxycephalus* Ward & Magath, 1917**

Description (after Stromberg *et al.* 1973). With characteristics of the genus.

Slender worms, widest in middle third of body and tapering slightly towards tail. Living worms red in colour. Cuticle with barely perceptible striae. Head straight, not bent ventrally. Mouth opening elongate. Buccal capsule divided into two sclerotized lateral valves with smooth longitudinal rib-like thickenings internally; inflation of valves forms sclerotized ring at junction of buccal cavity and oesophagus. Two trident-shaped processes at junction of valves, one dorsal, one ventral (Fig. 40A). Three pairs of simple circumoral papillae in outer circle; two pairs in inner circle at dorsal and ventral ends of mouth opening. Oesophagus with anterior club-shaped muscular portion, and posterior cylindrical glandular portion. Intestine straight. Anal lips slightly protruding.

Males: 4.57 (4.43–5.20) long; width 0.15 (0.12–0.18). Buccal capsule 0.103 (0.096–0.112) by 0.100 (0.096–0.107). Tridents 0.094 (0.086–0.104) long. Muscular oesophagus 0.390 (0.360–0.422), and glandular oesophagus 0.461 (0.428–0.530) long. Nerve ring 0.168–0.210 from anterior end. Single testis reaching almost to glandular oesophagus, then reflexed; reproductive tract with several swollen portions separated by constrictions. Tail 0.121 (0.109–0.136) long, rolled ventrally in mature worms, ending bluntly without a mucron. Thin caudal alae supported by papillae. Six pairs pre-cloacal, five pairs post-cloacal papillae. Spicules unequal but similar, left one weakly sclerotized, right one heavily so, 0.154 (0.146–0.166) long. Gubernaculum absent (Fig. 40B).

Females: 18.18 (15.93–25.05) long. Buccal capsule 0.137 (0.128–0.142) by 0.151 (0.136–0.165). Tridents 0.138 (0.134–0.144) long. Muscular oesophagus 0.569 (0.483–0.666), glandular oesophagus 0.652 (0.558–0.748) long. Nerve ring 0.262 (0.222–0.300) from anterior end. Vulva 2.24–3.11 from tail tip, lips slightly protruding. Vagina very muscular, directed posteriorly. Single ovary reaching level of muscular oesophagus, then reflexing; posterior branch of uterus reaching tail end, ending blindly in an highly muscular sac. Tail 1.87 (1.53–2.21) long, bluntly rounded without mucron (Fig. 40C). Ovoviviparous: larvae 0.635 (0.629–0.645) long.

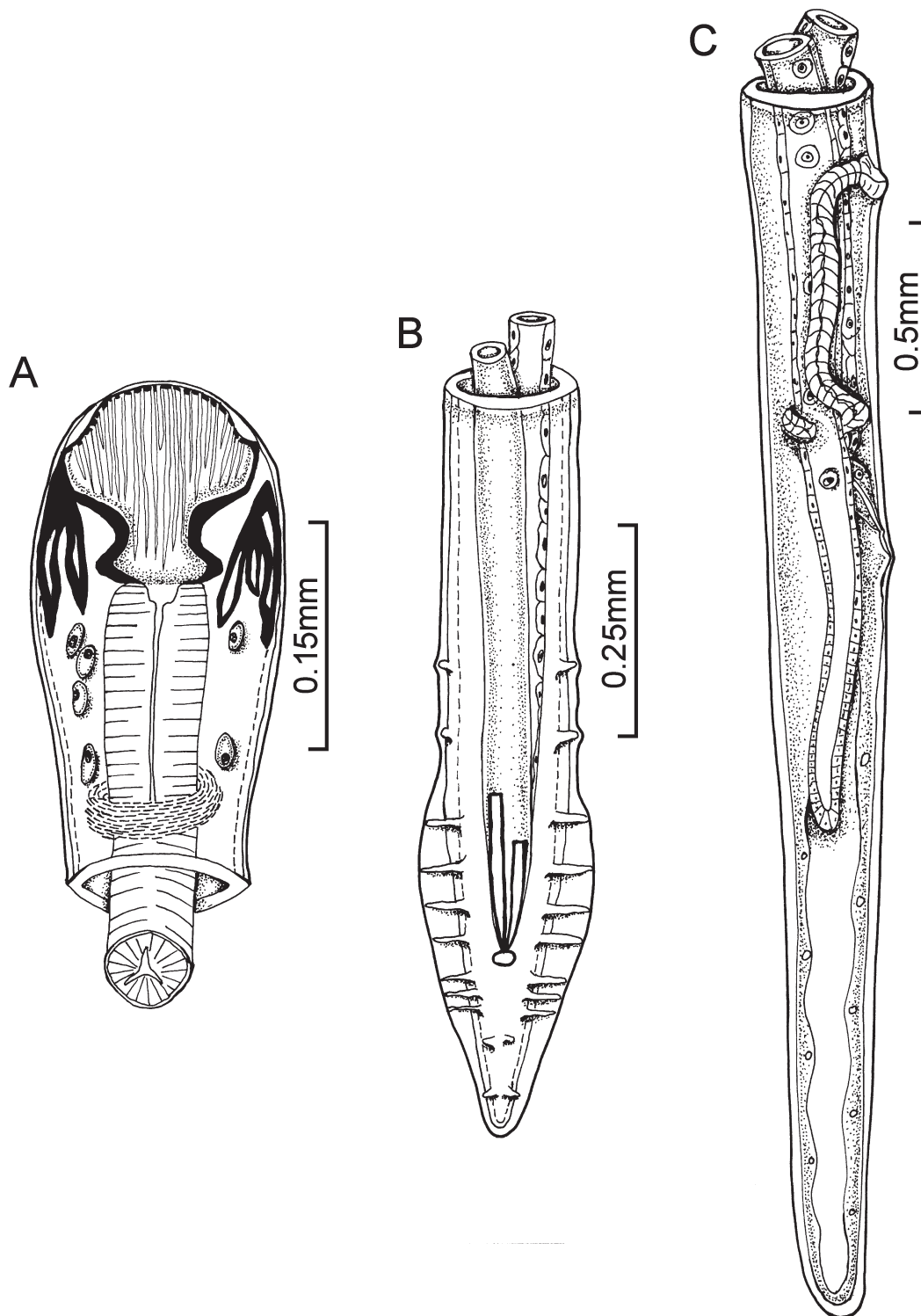


FIGURE 40. *Camallanus oxycephalus* Ward & Magath, 1917. A. adult, buccal capsule, lateral view; B. male, posterior end, ventral view; C. female, posterior end, lateral view. (A. redrawn from Stromberg & Crites 1974; B. and C. redrawn from Stromberg *et al.* 1973)

Site: intestine

Hosts: *Ambloplites rupestris* (1, 2, 7); *Ameiurus nebulosus* (4); *Ammocrypta pellucida* (1); *Aplodinotus grunniens* (1, 9); *Carpiodes cyprinus* (4, 9); *Catostomus commersonii* (3, 6); *Cottus bairdii* (3); *Culaea inconstans* (3); *Cyprinella spiloptera* (1); *Esox lucius* (7); *Etheostoma blennioides* (1); *Etheostoma exile* (3, 7); *Fundulus diaphanus* (7); *Hiodon tergisus* (1); *Ictalurus punctatus* (1); *Labidesthes sicculus* (1); *Lepomis gibbosus* (1, 7); *Lepomis macrochirus* (7); *Lota lota* (3); *Micropterus dolomieu* (1, 2, 3, 7, 8, 9, 10, 11); *Micropterus salmoides*

(1); *Morone chrysops* (1, 2, 9); *Notemigonus crysoleucas* (7, 12); *Notropis atherinoides* (1); *Notropis buccatus* (1); *Notropis heterodon* (1); *Notropis heterolepis* (1); *Notropis hudsonius* (1); *Notropis stramineus* (1); *Noturus flavus* (1); *Oncorhynchus kisutch* (7); *Perca flavescens* (1, 3, 9); *Percina caprodes* (1, 3, 7); *Percina copelandi* (1); *Percina maculata* (1); *Percopsis omiscomaycus* (1); *Pomoxis nigromaculatus* (1, 2, 7); *Rhinichthys cataractae* (1); *Salmo salar* (5); *Sander canadensis* (1, 3); *Sander vitreus* (1, 9)

Distribution: Nova Scotia, Ontario

Records: 1. Bangham & Hunter 1939 (ON); 2. Bangham 1955 (ON); 3. Dechtiar 1972a (ON); 4. Dechtiar 1972 b (ON); 5. Hare & Frantsi 1974 (NS); 6. Chan 1980 (ON); 7. Dechtiar & Christie 1988 (ON); 8. Dechtiar & Lawrie 1988 (ON); 9. Dechtiar & Nepszy 1988 (ON); 10. Dechtiar *et al.* 1988 (ON); 11. Dechtiar *et al.* 1989 (ON); 12. Forest & Cone 2011 (ON)

***Camallanus* sp.**

Site: alimentary tract

Hosts: *Acipenser fulvescens* (4); *Esox lucius* (2); *Perca flavescens* (1, 3)

Distribution: Hudson Bay Drainage, Labrador, Manitoba, Ontario

Records: 1. Tedla 1969 (ON); 2. Threlfall & Hanek 1970b (LB); 3. Tedla & Fernando 1972 (ON); 4. Choudhury & Dick 1998 (HBD, MB)

***Oncophora* Diesing, 1851**

Generic diagnosis (after Baudin-Laurencin 1971, Petter 1979, and Pinto *et al.* 1988). Camallanidae. Body elongated, tapering at each end. Buccal capsule with two valves, marked internally by numerous interrupted ridges in both sexes. Mouth opening slit-like. Pair of tridents associated with buccal capsule. Oesophagus comprises an anterior muscular portion, and a posterior glandular portion of about equal length. Cuticle thin, finely striated in both sexes.

One species, *O. melanocephala*, is known from one fish species in Canada.

***Oncophora melanocephala* (Rudolphi, 1819) Baudin-Laurencin, 1971**

Description (after Moravec *et al.* 1999). With characteristics of the genus. Relatively large worms with elongate body, adult females much longer than males; body of both sexes broadest posteriorly. Cuticle thick with fine, dense transverse striations. Body white, only buccal capsule darkly coloured, almost black. Mouth opening slit-like, formed by two lateral valves, strengthened on inner face by about 20 thin longitudinal thickenings (ribs or ridges) extending posteriorly to its base; a few ridges usually incomplete. Each valve has one dorso-lateral and one ventro-lateral cephalic papilla, one small lateral amphid, and two large, longitudinally elongated, sclerotized plates (shields) in outer buccal wall. Dorsal and ventral sides of anterior part of buccal capsule provided with large tridents. Anterior portion of capsule formed by valves followed by shorter and narrower posterior portion of capsule in form of thick-walled ring surrounding spacious buccal cavity (Fig. 41A). Posterior margin of this connecting ring followed by small, colourless, oesophageal cup. Oesophagus leads to straight narrow intestine. Small deirids located just behind nerve ring level.

Males (four specimens): 12.9–20.8 long, maximum width 0.245–0.354. Buccal capsule 0.141–0.207, and connecting ring 0.036–0.042 long. Each valve bears about 22 longitudinal ridges, some incomplete. Whole tridents 0.210–0.255 long. Muscular oesophagus 1.1–1.7, glandular oesophagus 1.2–1.6 long. Nerve ring and excretory pore 0.340–0.435 and 0.462–0.465 from anterior end (deirids not located). Posterior end with broad caudal alae supported by pedunculate papillae. Seven pairs of pre-cloacal and five pairs post-cloacal pedunculate caudal papillae. Cloacal opening surrounded by two transverse mounds, forming laterally two pairs of additional papillae (Fig. 41B). Right spicule well sclerotized, 0.579–0.843 long; left spicule hardly visible, 0.249–0.294 long. Tail conical, 0.084–0.138 long, sometimes with three poorly developed minute papilla-like outgrowths.

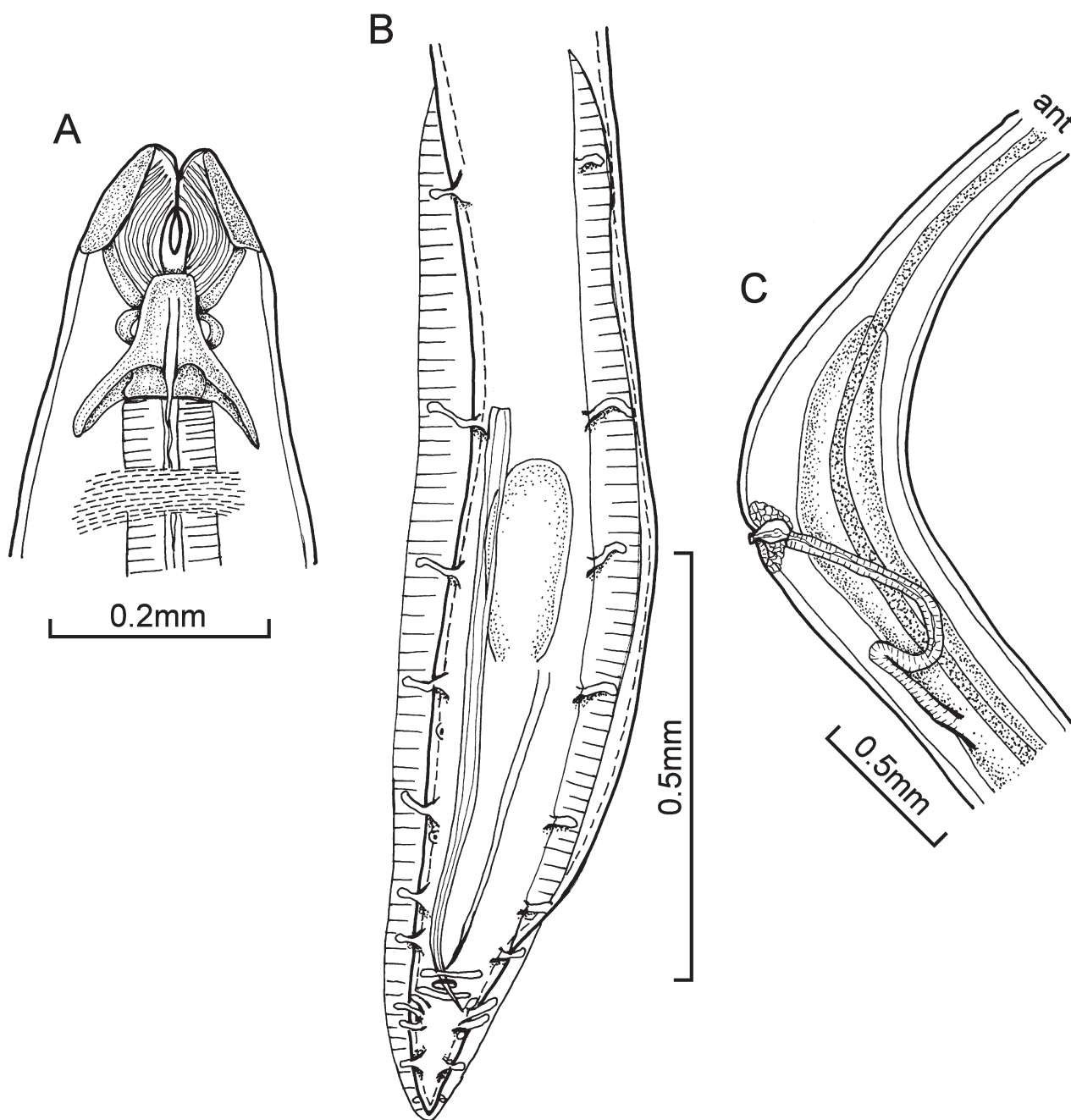


FIGURE 41. *Oncophora melanocephala* (Rudolphi, 1819) Baudin-Laurencin, 1971. A. young female, anterior end, dorso-ventral view; B. male, posterior end, ventral view; C. young female, vulvar region. (Redrawn from Moravec *et al.* 1999)

Females (one complete and two incomplete specimens with eggs; range of measurements of three juveniles in parentheses): Gravid worms markedly broad at approximately posterior third, and narrow filiform anteriorly. 53.8 (20.5–33.8) long. Width: anterior to vulva 0.204–0.367 (0.299–0.313), at vulva level 0.680–1.3 (0.258–0.394), at posterior part 0.544–0.898 (0.272–0.435). Buccal capsule 0.198 (0.198–0.204), and connecting ring 0.033 (0.030–0.033) long. Whole tridents 0.233 (0.219–0.240) long. Muscular oesophagus 1.9 (1.8–1.9), glandular oesophagus 1.8 (1.6–1.8) long. Nerve ring, excretory pore, and deirids 0.326 (0.340–0.394), (0.408–0.449) and 0.422 (0.400) from anterior end. Vulva not elevated, 12.1–18.5 (5.4–9.5) from posterior end of body. Ovijector with sclerotized walls, surrounded by mass of cells. Vagina muscular, narrow, directed posteriorly from vulva. Uterus extends a short distance anterior to vulva; uterus contains eggs (without eggs in juveniles) (Fig. 41C). Tail conical, 0.326–0.462 (0.286) long, with rounded tip bearing three minute, poorly developed papilla-like protrusions.

Site: stomach

Host: *Xiphias gladius*
Distribution: Atlantic
Record: Hogans *et al.* 1983

Superfamily THELAZIOIDEA Skryabin, 1915

Family RHABDOCHONIDAE Travassos, Artigas & Pereira, 1928

The Family Rhabdochonidae is represented in Canadian fishes by only one genus, namely, *Rhabdochona*. The phylogeny and biogeography of species of *Rhabdochona* from Canada and elsewhere in the Americas were investigated by Mejía-Madrid *et al.* (2007).

Rhabdochona Railliet, 1916

Generic diagnosis (after Moravec 2013). Rhabdochonidae. Medium sized nematodes. Pseudolabia rudimentary. Vestibule dilated to form well-defined funnel- or barrel-shaped prostom supported by longitudinal thickenings projecting anteriorly as teeth, variable in number. Deirids simple or bifurcate. Lateral alae present or absent. Oesophagus divided into anterior muscular portion and posterior glandular portion.

Males: many pre-cloacal and five to seven post-cloacal pairs of papillae; no caudal alae; spicules unequal and dissimilar; gubernaculum absent; tail conical, its tip rounded or with sharp point, rarely with several minute digital processes.

Females: amphidelphic; vulva about mid-body, tail tip rounded or with sharp point, sometimes with many spines, spikes or small mucronate points; eggs elliptical, embryonated, their shells smooth, filamented or with swellings (“formations”). Parasitic in intestine of fresh-water fishes.

Key to species of *Rhabdochona*

According to Moravec *et al.* (1981) the closest relative of *R. zacconis* Yamaguti, 1935 is probably *R. canadensis* Moravec & Arai, 1971; the two species “differ distinctly only in the position of the deirids (more anterior relative to length of the vestibule in *R. canadensis*) and the shape of the distal end and width of the left spicule”. There is possible confusion here because Moravec & Arai (1971) stated that the left spicule of *R. canadensis* is “conspicuously slender” but, at a width of 0.06–0.09 (see Moravec *et al.*, 1981), it is not as slender as that of *R. zacconis* at 0.012–0.015. For these reasons the following key does not attempt to distinguish the two species (although separate descriptions are given). It is relevant to point out that neither Anon. (1978) nor Arai & Mudry (1983) described or illustrated the worms from *Catostomus macrocheilus* in British Columbia that they claimed represented *R. zacconis*. This species has not been previously reported from North America so it is possible that the worms represented *R. canadensis* rather than *R. zacconis*.

- | | | |
|---|--|---------------------------|
| 1 | Mature eggs smooth, without filaments or gelatinous “formations” | 2 |
| - | Mature eggs with gelatinous “formations”, mostly in the shape of polar caps, or filaments | 4 |
| 2 | Left spicule longer than 0.8; length ratio of right to left spicule 1:10.2 to 1:11.9 | <i>R. decaturensis</i> |
| - | Left spicule shorter than 0.6; length ratio of right to left spicule 1:3.1 to 1:4.2 | 3 |
| 3 | Right spicule with truncated proximal end; tail ends in rounded tip | <i>R. rotundicaudatum</i> |
| - | Right spicule with bulbous, convex proximal end; tail ends in sharp point | <i>R. cascadilla</i> |
| 4 | Prostom with 16 teeth; egg surfaces covered with fine protuberances and numerous short filaments | <i>R. ovifilamenta</i> |
| - | Prostom with 10 or 14 teeth | 5 |
| 5 | Prostom with 10 teeth | 6 |
| - | Prostom with 14 teeth | 7 |
| 6 | Prostom lacks basal teeth; deirids small, bifurcate | <i>R. catostomi</i> |
| - | Prostom with basal teeth; deirids medium-sized, bifurcate; eggs with gelatinous “formations” covering most of poles and lateral surfaces | <i>R. kisutchi</i> |
| 7 | Tail tip rounded; eggs with two long single, rarely double, filaments; parasitic in Cottidae | <i>R. cotti</i> |

- Tail ends in sharp point 8
- 8 Both egg poles with numerous fine filaments *R. milleri*
- Both egg poles with at least one filament, sometimes two filaments on one or both poles *R. canadensis/R. zacconis*

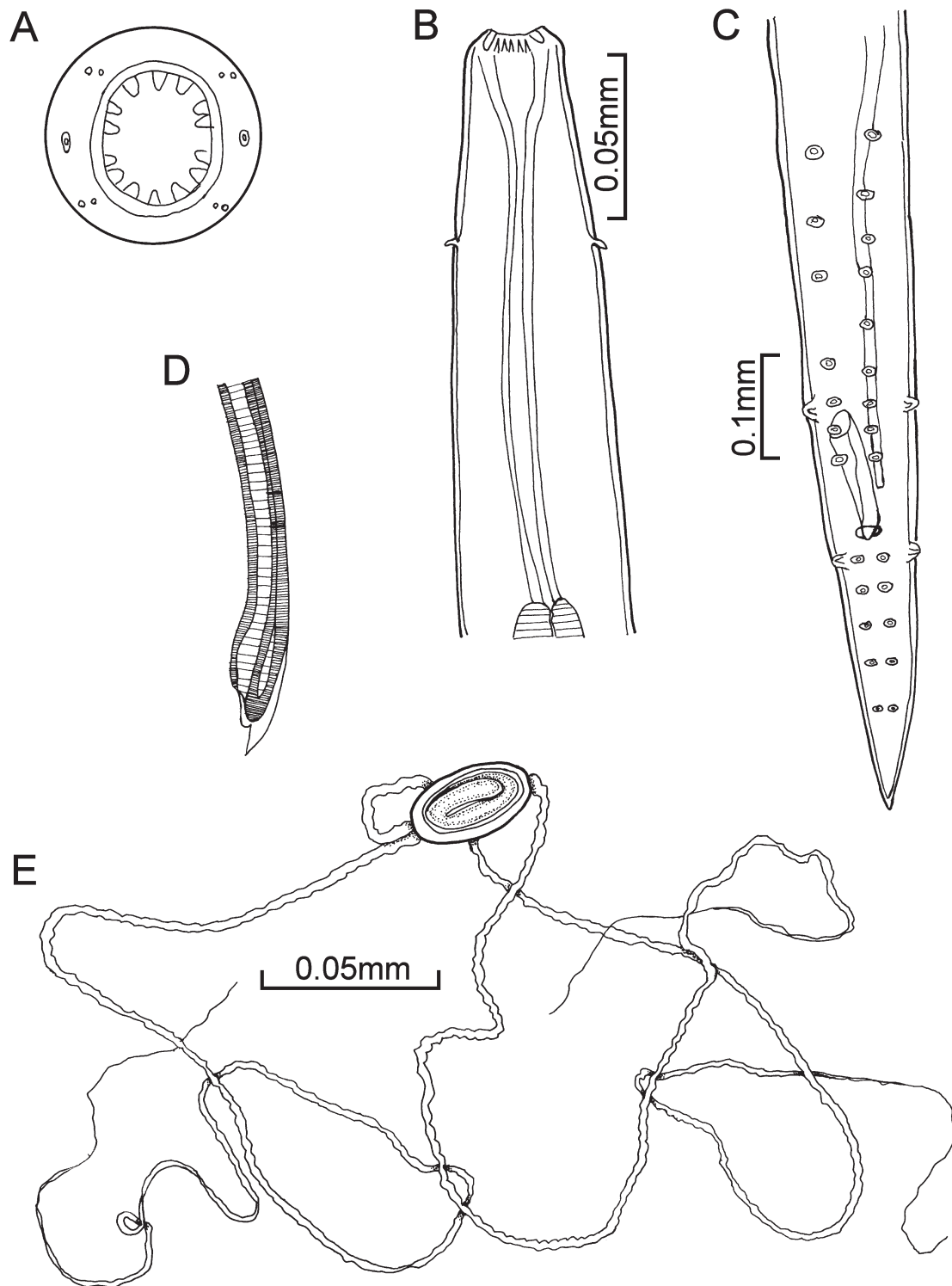


FIGURE 42. *Rhabdochona canadensis* Moravec & Arai, 1971. A. female, *en face* view; B. female, anterior end, dorsal view; C. male, posterior end, ventral view; D. distal tip of left spicule; E. mature egg. NB: scale bars were not provided in the original for either A. or D. (Redrawn from Moravec & Arai 1971)

***Rhabdochona canadensis* Moravec & Arai, 1971**

Description (after Moravec & Arai 1971). With characteristics of the genus.

Males (holotype measurements in parentheses): 5.74–8.36 (8.32) long, 0.109–0.150 (0.122) maximum width. Pseudolabia rudimentary. Prostom conspicuously wide, funnel-shaped, without basal teeth, 0.015–0.021 (0.021) long, 0.012–0.015 maximum width. Prostom lined internally with 14 longitudinal ridges, forming small teeth at their anterior ends (Fig. 42A,B). Vestibule including prostom 0.120–0.165 (0.165), muscular oesophagus 0.186–0.306 (0.216), and glandular oesophagus 2.18–3.90 (3.90) long. Small, bifurcate deirids 0.051–0.069 (0.069), nerve ring 0.177–0.207 (0.198), and excretory pore 0.237–0.279 (not located in holotype) from anterior end. Subventral pre-cloacal papillae asymmetrical in holotype (nine on one side, and seven on the other); the following combinations were seen in paratypes: 7+7, 7+9, 8+8 and 9+9 (Fig. 42C). Additional pair of lateral pre-cloacal papillae at level of 3rd subventral pair (counted from cloaca). Six pairs of post-cloacal papillae: five subventral and one lateral (Fig. 42C). Left spicule conspicuously slender, 0.471–0.525 (0.495) long and 0.06–0.09 wide at midlength [the figures for width from Moravec *et al.* 1981], with blade representing about the posterior half; distal tip lanceolate and thin, with cuticular membrane, bifurcate (Fig. 42D). Right spicule 0.102–0.129 (0.126) long, with dorsally reflected barb distally. Length ratio of right to left spicule 1:3.86 to 1:5.14 (1:3.91). Tail conical, 0.270–0.390 (0.390) long, with sharp terminal spike (Fig. 42C).

Females (allotype measurements in parentheses): gravid worms 9.88–27.92 (14.84) long, 0.190–0.408 (0.245) maximum width. Prostom wide, 0.021–0.033 (0.030) long. Vestibule including prostom 0.144–0.195 (0.186), muscular oesophagus 0.300–0.510 (0.480), and glandular oesophagus 3.26–5.07 (4.52) long. Deirids 0.063–0.078 (0.072), nerve ring 0.219–0.270 (0.237), and excretory pore 0.351–0.420 (0.369) from anterior end. Tail conical, 0.216–0.309 (0.231) long, terminating in sharp spike. Vulva post-equatorial, 4.27–13.15 (5.90) from posterior end of body. Mature eggs oval, embryonated, 0.036–0.042 x 0.018–0.021 (0.036–0.042 x 0.018–0.021), with one or two long filaments on each pole. Fully mature eggs usually with two filaments on one pole and only one filament on the other pole (Fig. 42E); however, often two filaments on both poles. Filaments very long (*ca* 0.6) with relatively wide bases and ends sometimes frayed.

Site: intestine

Hosts: *Catostomus commersonii* (10, 11); *Cottus* sp. (5); *Couesius plumbeus* (1, 8); *Esox lucius* (1); *Hiodon alosoides* (10, 11); *Margariscus margarita* (9); *Moxostoma anisurum* (10, 11); *Noturus flavus* (1); *Oncorhynchus mykiss* (3, 5); *Percopsis omiscomaycus* (10, 11); *Chrosomus eos* (9, 12); *Phoxinus neogaeus* (9); *Platygobio gracilis* (1); *Rhinichthys cataractae* (1, 6, 7); *Salvelinus malma* (2, 4); *Sander vitreus* (1); *Semotilus atromaculatus* (9); *Semotilus corporalis* (9)

Distribution: Alberta, British Columbia, Manitoba, Ontario

Records: 1. Moravec & Arai 1971 (AB); 2. Anon. 1978 (BC); 3. Pybus & Samuel 1978 (AB); 4. Arai & Mudry 1983 (BC); 5. McAllister & Mudry 1983 (AB); 6. Dechtiar & Christie 1988 (ON); 7. Dechtiar & Lawrie 1988 (ON); 8. Dechtiar *et al.* 1988 (ON); 9. Dechtiar *et al.* 1989 (ON); 10. Szalai 1989 (MB); 11. Szalai *et al.* 1992 (MB); 12. Marcogliese *et al.* 2001 (ON)

***Rhabdochona cascadilla* Wigdor, 1918**

Synonyms: *Rhabdochona* sp. of Bangham (1941 *partim*); *Rhabdochona* sp. of Bangham & Venard (1946 *partim*)

Description (after Byrne 1992a). With characteristics of the genus. General characteristics: outer circle of four cephalic papillae and inner circle of four labial papillae present. Prostom armed with 14 longitudinal sclerotized rods projecting anteriorly as teeth, of which three are dorsal, three ventral, two pairs ventro-lateral, and two pairs dorso-lateral. Sclerotized protuberances present in basal part of prostom [= basal teeth?]. Deirids small, bifurcate, located about the midpoint of vestibule.

Male paratypes (means with ranges in parentheses): body 4.5 (4.0–5.1), prostom 0.016 (0.012–0.019), vestibule 0.076 (0.068–0.085), muscular oesophagus 0.159 (0.146–0.227) and glandular oesophagus 1.1 (0.8–1.8) long. Deirids 0.047 (0.039–0.054), nerve ring 0.124 (0.118–0.134) and excretory pore 0.198 (0.182–0.210) from anterior end. Caudal papillae digitiform: 14 to 19 pre-cloacal and 12 (six pairs) post-cloacal, mostly subventral.

Phasmids minute, located just distal to most posterior pair of caudal papillae. Left spicule 0.378 (0.320–0.415), its alate portion (blade) 0.171 (0.153–0.190) long. Right spicule 0.118 (0.103–0.128) long, with dorsally projecting barb at distal end, and a bulbous, convex proximal end. Length ratio of right to left spicule 1:3.20 (1:3.11 to 1:3.24). Tail 0.277 (0.212–0.322) long, tapering and ending in pointed tip (Fig. 43A,B).

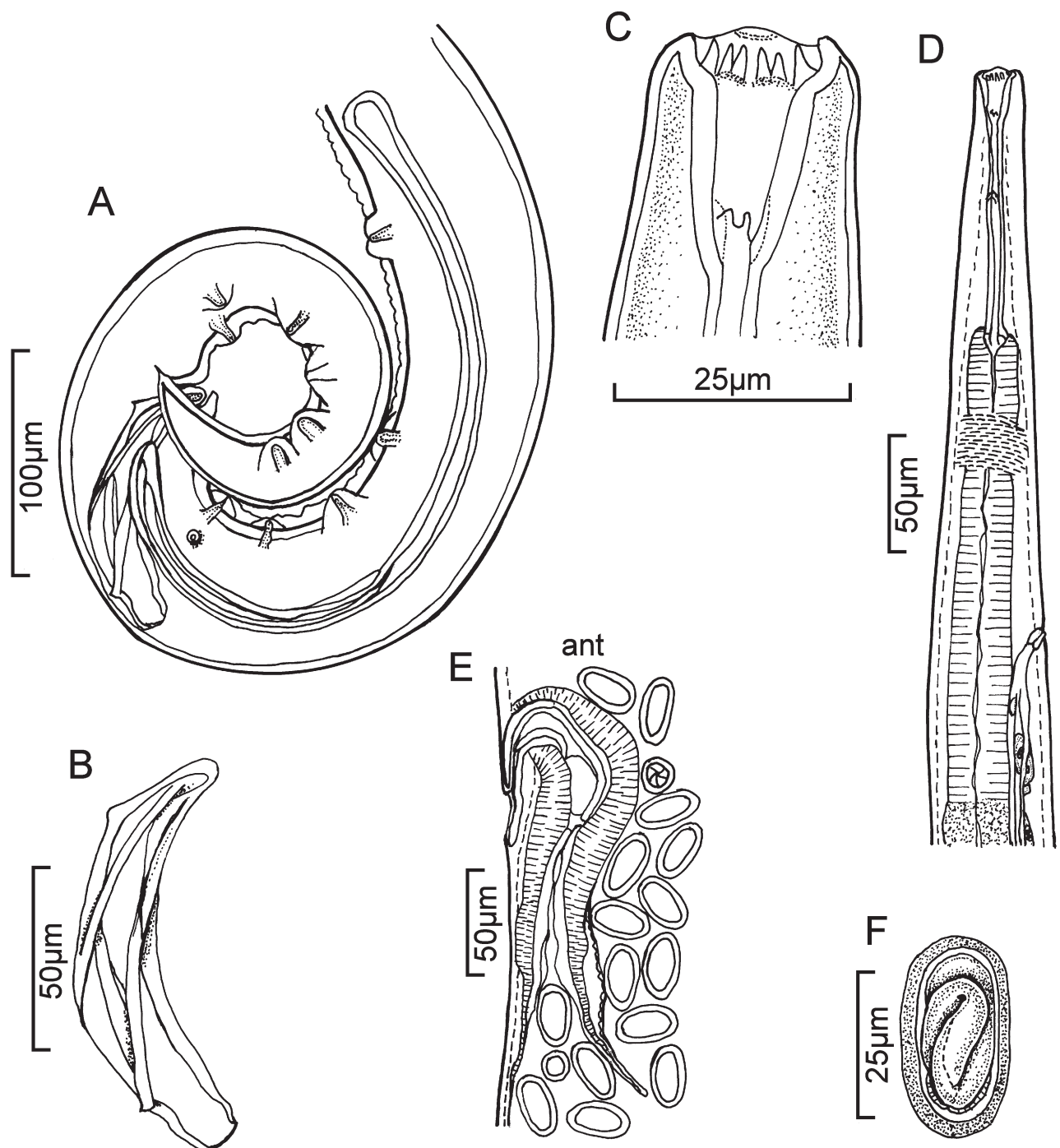


FIGURE 43. *Rhabdochona cascadilla* Wigdor, 1918. A. male, posterior end, lateral view; B. right spicule, lateral view; C. female, head, lateral view; D. female, anterior end, lateral view; E. vulva, vagina and distal uterus, lateral view; F. embryonated egg. (Redrawn from Byrne 1992a)

Female paratypes (means with ranges in parentheses): body 8.4 (6.4–9.9), prostom 0.024 (0.019–0.027), vestibule 0.089 (0.076–0.097), muscular oesophagus 0.198 (0.175–0.227) and glandular oesophagus 1.4 (1.1–1.6) long. Deirids 0.055 (0.050–0.062), nerve ring 0.147 (0.134–0.159) and excretory pore 0.235 (0.200–0.266) from anterior end (Fig. 43C,D). Vulva near midpoint of body, 4.4 (3.5–5.0) from anterior end (Fig. 43E). Phasmids

minute, posterior to midpoint of tail. Eggs ovoid, smooth, without filaments or floats (Fig. 43F), 0.017 (0.017–0.019) x 0.033 (0.031–0.034). Tail 0.228 (0.184–0.287) long, tapering and ending in pointed tip.

Comments: the 41 fish species listed below have been reported as hosts of *R. cascadilla* in Canada. However, according to Byrne (1992a) the numerous reports of this rhabdochonid species “across much of Canada and the United States, from at least 64 species of fish (Byrne 1989) should be accepted with reservation”.

Site: intestine

Hosts: *Acipenser fulvescens* (7, 20, 22); *Acrocheilus alutaceus* (6); *Ambloplites rupestris* (1); *Ameiurus nebulosus* (4); *Carpionodes cyprinus* (1); *Catostomus catostomus* (6, 10, 13); *Catostomus commersonii* (4, 9, 10, 13); *Catostomus macrocheilus* (6); *Couesius plumbeus* (6); *Culaea inconstans* (17); *Cyprinella spiloptera* (1); *Etheostoma exile* (5, 7, 8); *Etheostoma nigrum* (5, 7, 8); *Hiodon tergisus* (1); *Lota lota* (8); *Luxilus cornutus* (2, 3, 5, 7, 16, 17, 18, 19); *Margariscus margarita* (2, 3, 4); *Micropterus dolomieu* (3); *Moxostoma macrolepidotum* (1); *Mylocheilus caurinus* (6, 12, 14); *Nocomis biguttatus* (18, 19); *Notemigonus crysoleucas* (23); *Notropis anogenus* (8); *Notropis hudsonius* (1, 5, 7, 8); *Notropis stramineus* (1); *Notropis volucellus* (1); *Oncorhynchus clarkii* (6); *Oncorhynchus mykiss* (6); *Oncorhynchus nerka* (6, 9, 17); *Perca flavescens* (9); *Percopsis omiscomaycus* (9); *Chrosomus eos* (3, 21); *Prosopium williamsoni* (6); *Pimephales notatus* (3, 5, 7); *Ptychocheilus oregonensis* (6, 12, 14); *Rhinichthys atratulus* (8); *Rhinichthys cataractae* (6); *Richardsonius balteatus* (6, 12, 14); *Salvelinus fontinalis* (4, 11); *Semotilus atromaculatus* (2, 3, 4, 5, 7, 15, 17); *Semotilus corporalis* (3)

Distribution: Alberta, British Columbia, Hudson Bay Drainage, Manitoba, Nova Scotia, Ontario, Quebec

Records: 1. Bangham & Hunter 1939 (ON); 2. Bangham 1941 (ON); 3. Bangham & Venard 1946 (ON); 4. Choquette 1951a (QC); 5. Bangham 1951 (ON); 6. Bangham & Adams 1954 (BC); 7. Bangham 1955 (ON); 8. Dechtiar 1972a (ON); 9. Collins & Dechtiar 1974 (ON); 10. Leong 1975 (AB); 11. Mudry & Anderson 1977 (AB); 12. Anon. 1978 (BC); 13. Leong & Holmes 1981 (AB); 14. Arai & Mudry 1983 (BC); 15. Mackie *et al.* 1983 (ON); 16. Byrne & Baker 1987 (ON); 17. Dechtiar *et al.* 1988 (ON); 18. Byrne 1992a (ON); 19. Byrne 1992b (ON); 20. Choudhury & Dick 1993 (MB); 21. Dubois *et al.* 1996 (QC); 22. Choudhury & Dick 1998 (HBD, MB); 23. Forest & Cone 2011 (NS)

***Rhabdochona catostomi* Kayton, Kritsky & Tobias, 1979**

Description (after Kayton *et al.* 1979). With characteristics of the genus. Body filiform, males smaller than females. Caudal end conical with terminal spike. Mouth with two bilateral rudimentary pseudolabia, two large bilateral amphids, outer circle of cephalic papillae (inner circle apparently absent). Prostom funnel-shaped, lacking basal teeth, its inner wall with 10 longitudinal cuticular ridges terminating in anterior teeth. Cuticle lines entire vestibule. Oesophagus with anterior muscular and wider posterior glandular regions. Deirids small, bifurcate, lying slightly anterior to mid-vestibule.

Males: body 8.9–14.3 long, 0.173–0.211 maximum width. Prostom 0.022–0.034, vestibule 0.134–0.174, muscular oesophagus 0.336–0.372, and glandular oesophagus 3.5–4.8 long. Deirids 0.076–0.085, nerve ring 0.204–0.238, and excretory pore 0.484 from anterior end. Tail 0.336–0.392 long, curved ventrally. Caudal alae absent. Subventral caudal papillae variable in number, 8 or 9 pre-cloacal, and 5 post-cloacal pairs (Fig. 44A). Left spicule 0.546–0.562 long, slender, with ventral groove, its tip with ventral barb, bifurcate. Right spicule 0.151–0.154 long, with reflected distal barb (Fig. 44B). Length ratio of right to left spicule 1:3.62 to 1:3.65.

Females: body 15.3–16.7 long, 0.248–0.292 maximum width. Prostom 0.028–0.031, vestibule 0.154–0.176, muscular oesophagus 0.375–0.417, and glandular oesophagus 4.97–6.10 long. Deirids 0.090–0.097 and nerve ring 0.227–0.284 from anterior end [position of excretory pore not stated]. Tail 0.227–0.280 long, usually straight (Fig. 44C). Vulva post-equatorial comprising a transverse slit surrounded by elevated labia. Mature eggs ellipsoidal, embryonated, “poles usually with complex elongate filaments”, measuring 0.031–0.036 x 0.020–0.024 (Fig. 44D).

Site: intestine

Host: *Catostomus catostomus*

Distribution: Alberta

Record: Kayton *et al.* 1979

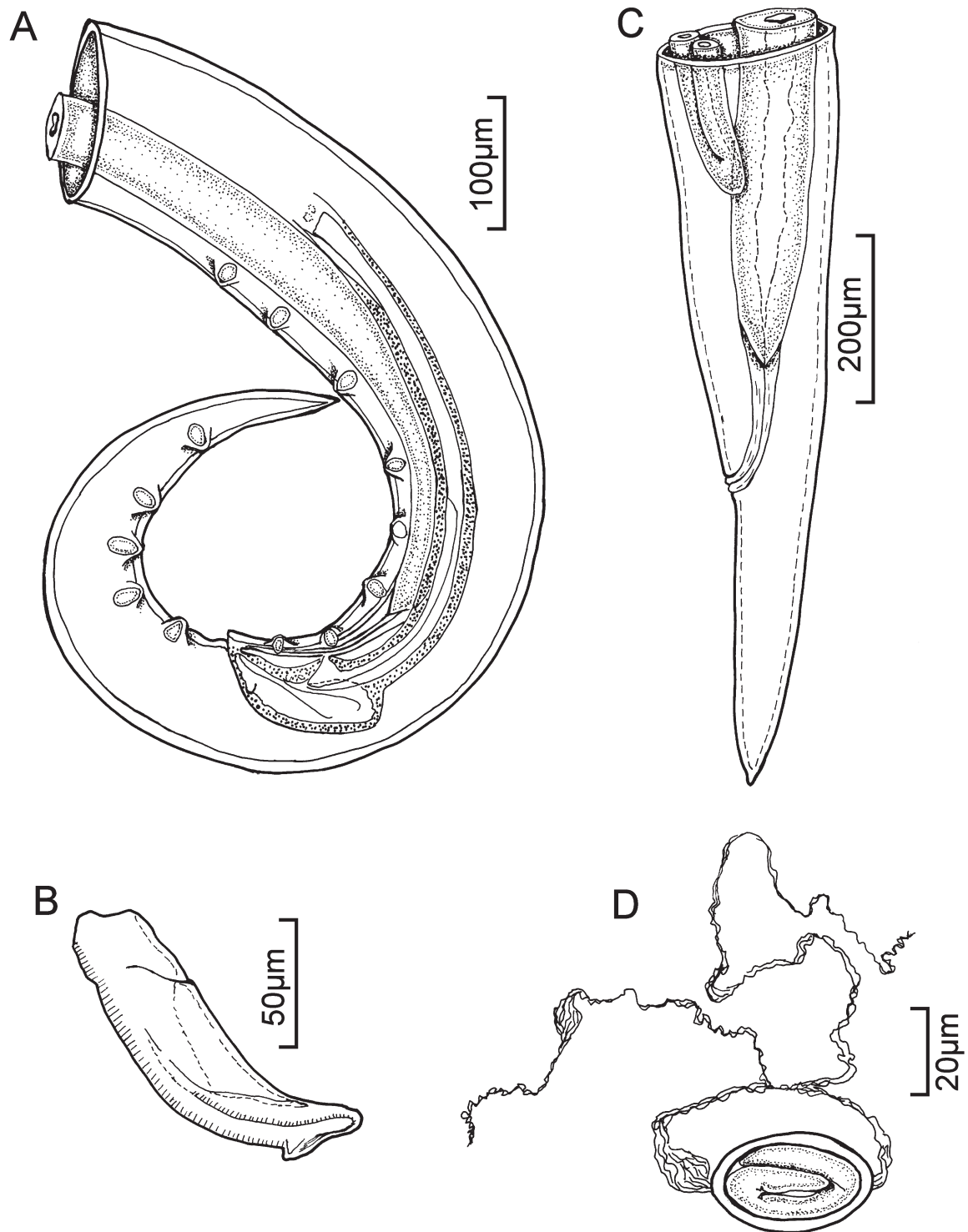


FIGURE 44. *Rhabdochona catostomi* Kayton, Kritsky & Tobias, 1979. A. male, posterior end, lateral view; B. right spicule, lateral view; C. female, posterior end, lateral view; D. mature egg. (Redrawn from Kayton *et al.* 1979)

***Rhabdochona cotti* Gustafson, 1949**

Description (after Gustafson 1949, and Moravec & Arai 1971). With characteristics of the genus. Slender worms, attenuated at both ends. Pseudolabia rudimentary. Prostom funnel-shaped, without basal teeth, with 14 teeth projecting anteriorly from longitudinal ridges. Oesophagus comparatively short, divided into anterior muscular and

posterior glandular portions. Deirids small (“shape of deirids not determined”), lateral, opposite mid-portion of buccal cavity.

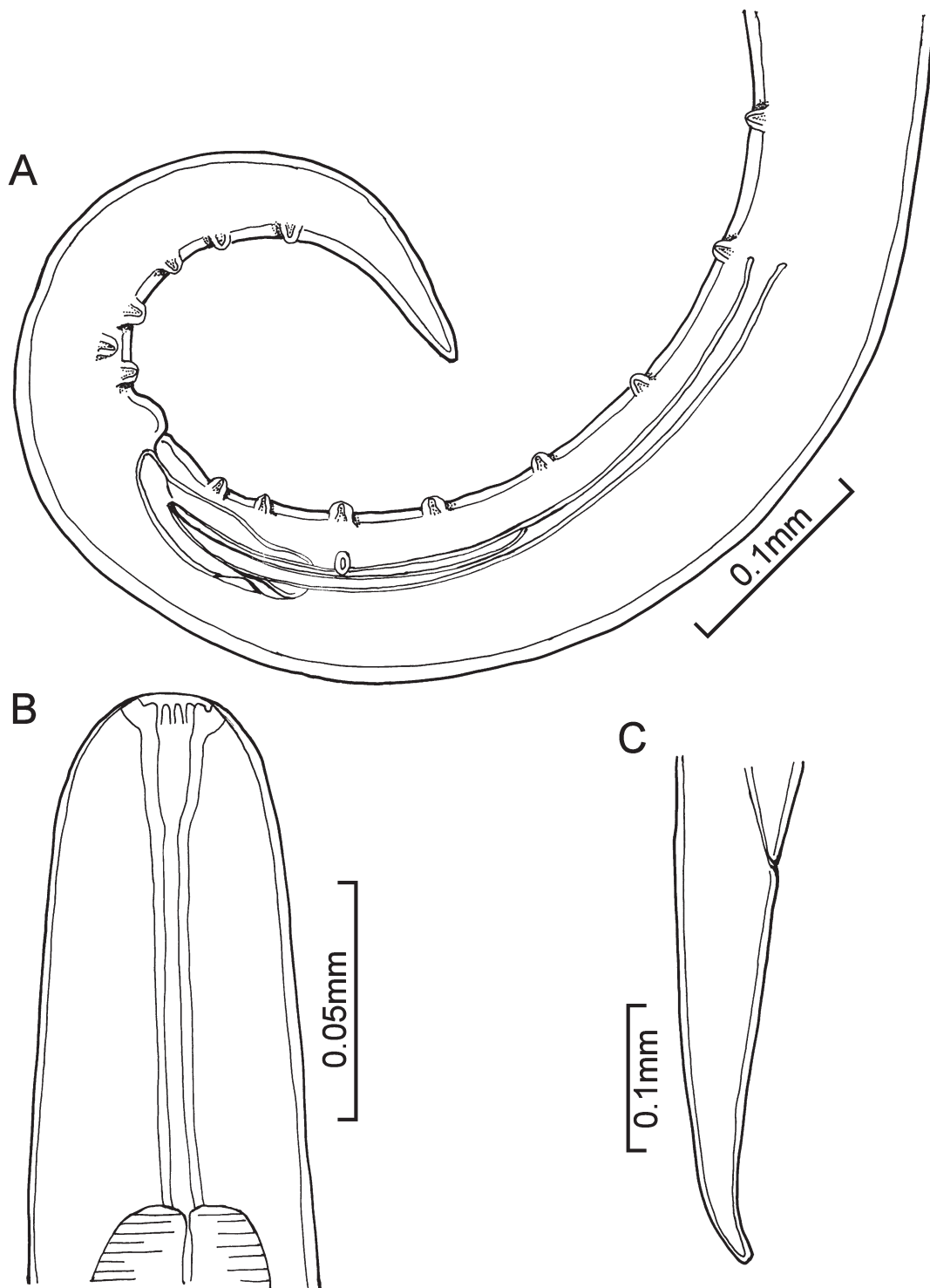


FIGURE 45. *Rhabdochona cotti* Gustafson, 1949. A. male, posterior end, lateral view; B. female, anterior end, lateral view; C. female tail, lateral view. (Redrawn from Moravec & Arai 1971)

Males (measurements of paratypes according to Moravec & Arai (1971) in parentheses): 7.65–10.6 (12.76) long, 0.080–0.131 (0.154) maximum width. Prostom 0.017–0.020 (0.015), “total stoma” 0.082–0.122 (vestibule including prostom 0.093–0.096), muscular oesophagus 0.272–0.340 (0.252–0.285), and glandular oesophagus 0.80–1.28 (0.87–1.22) long. Nerve ring 0.17–0.22 (0.165–0.195) and excretory pore 0.22–0.32 (0.216) from anterior end. Left spicule 0.309–0.370 (0.354–0.357) long, of which 0.163–0.197 is the alate portion; according to

Moravec & Arai (*op. cit.*) its distal tip appears “lanceolate and similar to that of *R. canadensis*” (see above). Right spicule 0.085–0.120 (0.102–0.105) long, scoop-shaped, with rounded posterior end lacking distinct barb distally. Length ratio of right to left spicule 1:3.08 to 1:–3.64. About eight pairs of pre-cloacal papillae, all subventral except for the 3rd sublateral pair anterior to cloaca. Six pairs of post-cloacal papillae, of which the 2nd pair is sublateral and the others subventral. Tail conical, 0.285–0.294 long, with distinctly rounded tip, without cuticular spike (Fig. 45A).

Females (measurements of paratypes according to Moravec & Arai (1971) in parentheses): 18.3–34.2 (19.20–29.48) long, 0.19–0.31 (0.258–0.462) maximum width. Prostom 0.025–0.036 (0.024–0.027), “total stoma” 0.102–0.143 (vestibule including prostom 0.099–0.111) [Fig. 45B], muscular oesophagus 0.374–0.626 (0.330), glandular oesophagus 1.46–1.92 (not determined) long. Nerve ring 0.21–0.43, excretory pore 0.305–0.580, and vulva 11.4–20.9 from anterior end. Tail 0.204–0.350 (0.210–0.300) long, conical with distinct rounded tip, without cuticular spike (Fig. 45C). Eggs embryonated when laid, 0.032–0.033 x 0.018–0.020, with two long single (rarely double) filaments.

Site: intestine

Hosts: *Cottus asper* (1); *Cottus bairdii* (2, 6, 7); *Cottus cognatus* (1, 3, 4, 5, 8); *Cottus caeruleomentum* (9)

Distribution: Alberta, British Columbia, Ontario

Records: 1. Bangham & Adams 1954 (BC); 2. Dechtiar 1972a (ON); 3. Mudry & Anderson 1977 (AB); 4. Anon. 1978 (BC); 5. Arai & Mudry 1983 (BC); 6. Dechtiar *et al.* 1988 (ON); 7. Dechtiar & Lawrie 1988 (ON); 8. Dechtiar *et al.* 1989 (ON); 9. Moravec & Muzzall 2007 (BC)

***Rhabdochona decaturensis* Gustafson, 1949**

Description (after Gustafson 1949, and Moravec & Arai 1971). With characteristics of the genus. Small, slender, worms, attenuated at both ends. Pseudolabia rudimentary. Buccal cavity heavily sclerotized, funnel-shaped prostom containing 14 minute teeth projecting anteriorly from longitudinal ridges; four minute teeth at base of prostom (Fig. 46A). Oesophagus relatively long, divided into anterior muscular and posterior glandular portions. Deirids very small, simple, lateral, opposite mid-portion of buccal cavity.

Males (measurements of a paratype according to Moravec & Arai (1971) in parentheses): 6.8–8.0 long (13.29), 0.085–0.100 (0.132) maximum width. Prostom 0.015–0.017 (0.018), “total stoma” 0.096–0.110 (vestibule including prostom 0.120), muscular oesophagus 0.21–0.27 (0.255), glandular oesophagus 1.70–2.0 (3.52), and tail 0.25–0.31 (0.296) long, with terminal cuticular spike. Nerve ring 0.140–0.170 (0.180) and excretory pore 0.210–0.250 (0.273) from anterior end. Left spicule relatively long at 0.830–1.025 (1.074), with conical distal tip, not bifurcated; spicule shaft representing 73% of entire length. Right spicule 0.075–0.100 (0.090) long, scoop-shaped, with reflected barb near tip on left side. Length ratio of right to left spicule 1:10.25 to 1:11.93. About eight (seven) pairs of pre-cloacal papillae, of which seven pairs are subventral, and one pair sublateral. Six (six) pairs of post-cloacal papillae, of which the 2nd pair is sublateral, the others subventral (Fig. 46B).

Females (measurements of a paratype according to Moravec & Arai (1971) in parentheses): 9.2–13.4 (21.25) long, 0.093–0.160 (0.198) maximum width. Prostom 0.016–0.025 (0.024), “total stoma” 0.090–0.110 (vestibule including prostom 0.120), muscular oesophagus 0.217–0.320 (0.299), glandular oesophagus 1.92–2.6 (4.38), and tail 0.16–0.23 long (0.165) with cuticular terminal spike (Fig. 46C). Nerve ring 0.150–0.170 (0.183) and excretory pore 0.236–0.257 (0.270) from anterior end. Eggs embryonated when laid, ovoid, 0.031–0.038 x 0.015–0.023, bearing no filaments.

Site: intestine

Hosts: *Luxilus cornutus* (2, 3); *Notropis hudsonius* (1, 2, 3); *Noturus flavus* (1); *Noturus gyrinus* (1)

Distribution: Ontario

Records: 1. Dechtiar & Christie 1988; 2. Dechtiar & Lawrie 1988; 3. Dechtiar *et al.* 1988

***Rhabdochona kisutchi* Margolis, Moravec & McDonald, 1975**

Description (after Margolis *et al.* 1975). With characteristics of the genus.

Medium-sized worms with rudimentary pseudolabia. Mouth opening roughly hexagonal. Two fairly large lateral amphids and eight small submedian cephalic papillae arranged in an inner and outer circle of four each; papillae of inner circle at mouth margin. Prostom funnel-shaped with distinct basal teeth, and its anterior margin with 10 conical teeth (Fig. 47A,B). Vestibule relatively long, straight (but S-shaped in specimens that the authors claim to be “older”). Deirids medium-sized, bifurcate, located near mid-point of vestibule (Fig. 47B). Tail of both sexes “ending in blunt point”.

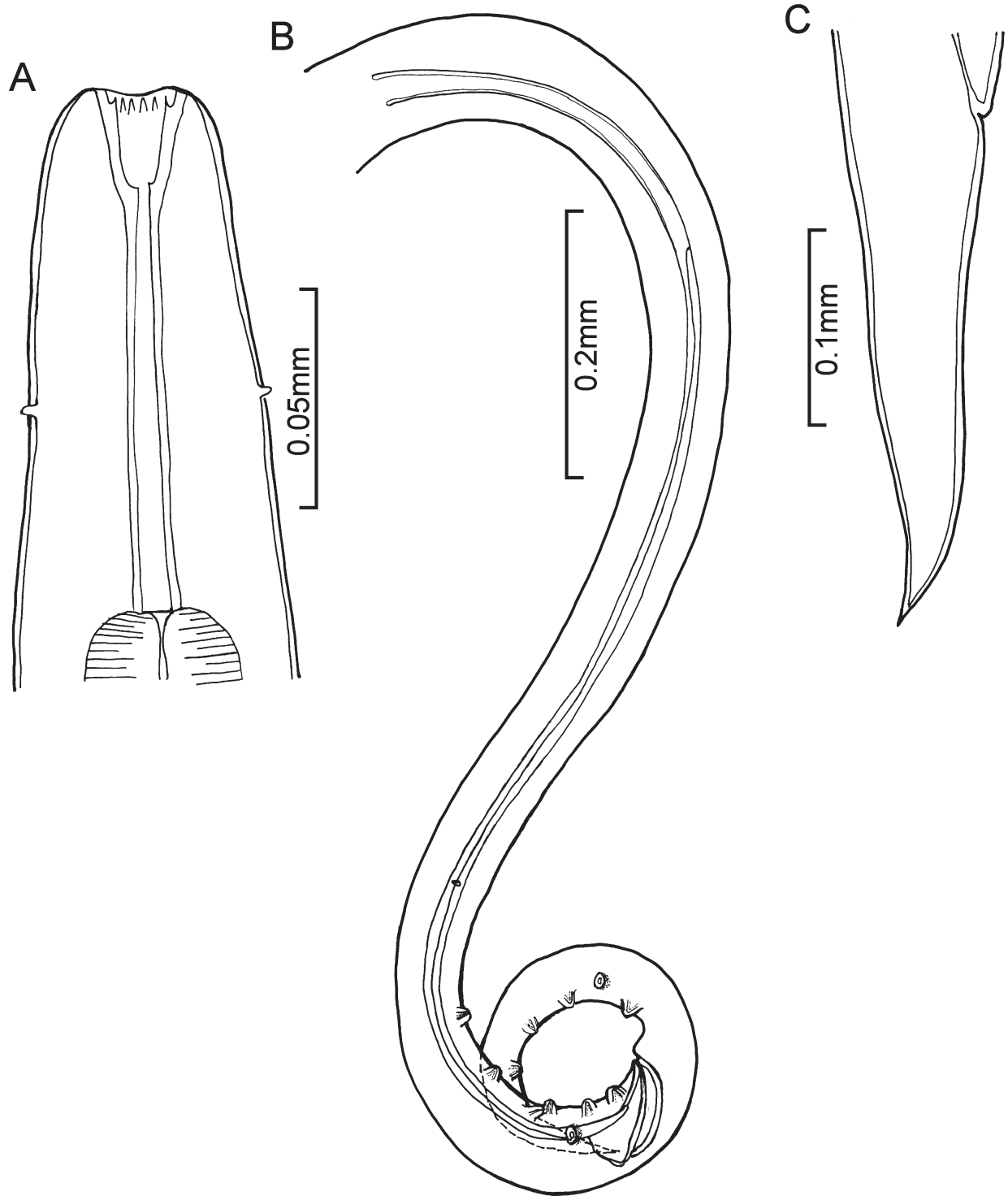


FIGURE 46. *Rhabdochona decaturensis* Gustafson, 1949. A. female, anterior end, dorsal view; B. male, posterior end, lateral view; C. female tail, lateral view. (Redrawn from Moravec & Arai 1971)

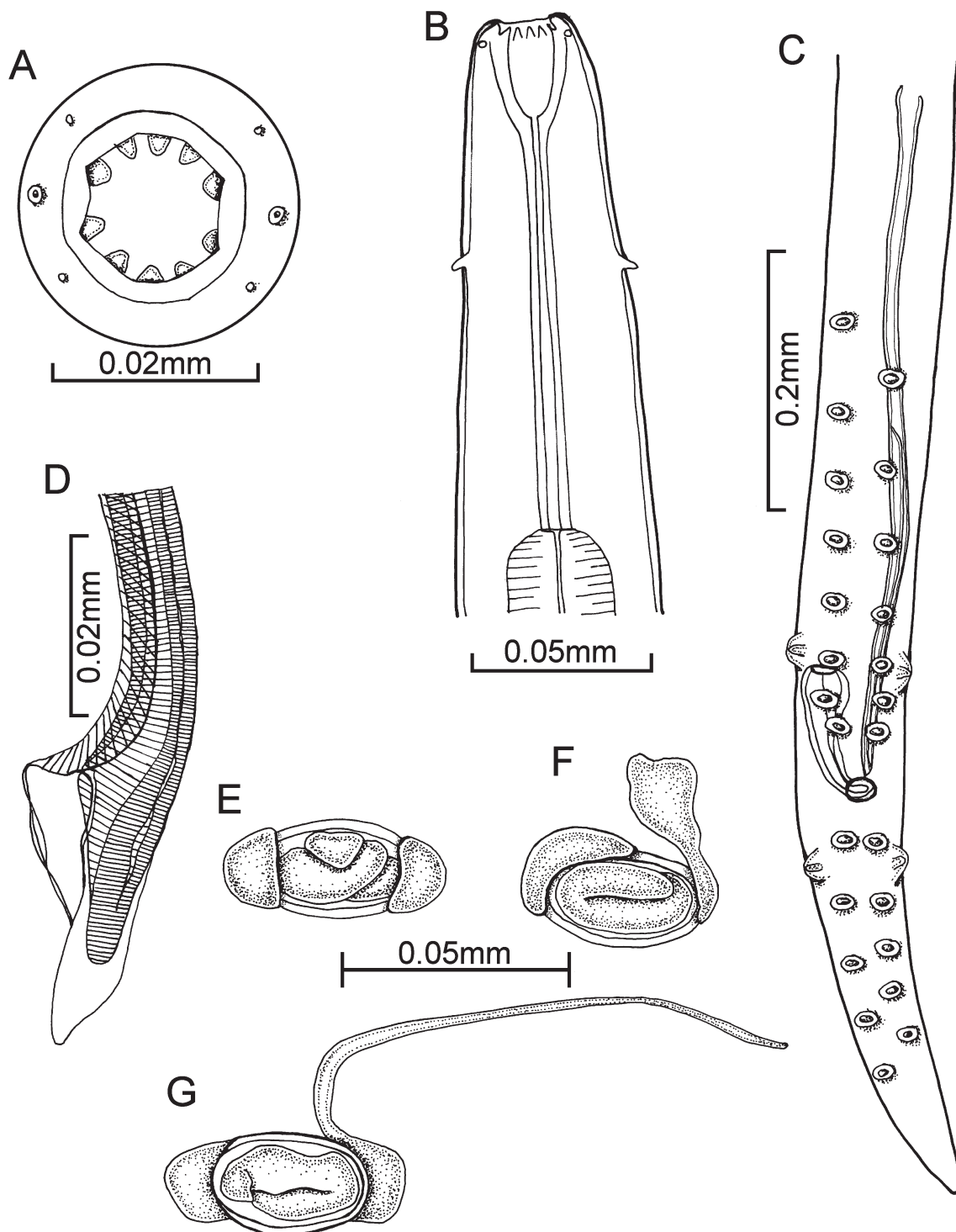


FIGURE 47. *Rhabdochona kisutchi* Margolis, Moravec & McDonald, 1975. A. female, *en face* view; B. female, anterior end, dorsal view; C. male, posterior end, ventral view; D. left spicule, distal tip; E. and F. variation in shape of polar “formations” on eggs; G. egg with polar filament (truncated). (Redrawn from Margolis *et al.* 1975)

Males (11 specimens, allotype in parentheses): 6.61–8.41 (6.90) long, 0.110–0.150 (0.150) maximum width. Prostom 0.024–0.027 (0.024), vestibule including prostom 0.108–0.153 (0.123), muscular oesophagus 0.225–0.270 (0.233) and glandular oesophagus 1.35–2.29 (1.69) long. Deirids 0.060–0.075 (0.066), nerve ring 0.168–0.240 (0.195) and excretory pore 0.249–0.351 (0.286) from anterior end. Subventral pre-cloacal papillae variable in number: allotype has nine on each side, paratypes with the combinations 7+8, 8+8, 8+9, 7+9, 8+10, and 10+10. Additional pair of lateral pre-cloacal papillae at level of 3rd subventral pair or slightly posterior to it. One paratype

had two pairs of lateral papillae. Six pairs of post-cloacal papillae—five subventral and one lateral (Fig. 47C). Left spicule 0.564–0.660 (0.627) long, with shaft representing about its distal half; proximal end slightly widened, distal tip lanceolate, with wide cuticular membrane; ventral process seen on distal tip when spicule protruding from cloacal opening (Fig. 47D). Right spicule variable in shape, 0.087–0.135 (0.120) long; dorsal barb feebly developed, usually indistinct, its apparent presence depending perhaps on angle from which it is viewed. Length ratio of right to left spicule 1:4.80 to 1:6.48 (1:5.22). Tail 0.300–0.390 (0.360) long, “ending in blunt point”.

Females (nine specimens, holotype in parentheses): gravid worms 12.04–17.38 (13.59) long, 0.190–0.272 (0.231) maximum width. Prostom funnel-shaped 0.030–0.036 (0.033), vestibule including prostom 0.126–0.198 (0.192), muscular oesophagus 0.285–0.361 (0.330), and glandular oesophagus 2.34–3.36 (2.87) long. Deirids 0.060–0.096 (0.090), nerve ring 0.174–0.276 (0.261) and excretory pore 0.411–0.420 (0.411) from anterior end. Tail 0.351–0.450 (0.351) long, ending in “a blunt point”. Vulva slightly post-equatorial located 6.16–8.02 (6.25) from posterior end. Amphidelphic. Mature eggs oval, embryonated, always with gelatinous “formations” most often in shape of caps or lobes covering egg poles and partly their lateral surfaces; rarely polar “formations” tendril-shaped and as long as 0.045; in some eggs a long filiform filament, about 0.45 long, arises from proximo-lateral corner of one polar cap (Fig. 47E,F,G). Eggs, excluding polar “formations”, “0.039–0.042 x 0.024 (0.039–0.042 x 0.024) [sic]”, polar caps usually 0.006–0.009 high.

Sites: intestine, pyloric caeca

Hosts: *Oncorhynchus kisutch* (1); *Oncorhynchus mykiss* (2, 3); *Oncorhynchus nerka* (2, 3); *Prosopium williamsoni* (2, 3); *Salvelinus malma* (2, 3, 4)

Distribution: British Columbia

Records: 1. Margolis *et al.* 1975; 2. Anon. 1978; 3. Arai & Mudry 1983; 4. Anon. 1984

***Rhabdochona milleri* Choquette, 1951**

Description (after Choquette 1951a, and Moravec & Arai 1971). With characteristics of the genus.

Male (1 specimen): 6.94 long, 0.176 maximum width. Prostom funnel-shaped, 0.018 long, with distinct basal teeth, lined internally with longitudinal ribs forming teeth directed forwardly (exact number not determined). Vestibule including prostom 0.144, muscular oesophagus 0.300, and glandular oesophagus 1.36 long. Small, bifurcate deirids 0.063, nerve ring 0.168, and excretory pore 0.237 from anterior end. Eight pairs of subventral and one pair of [presumably lateral] pre-cloacal papillae, and six pairs of post-cloacal papillae—five pairs subventral, one pair lateral (Fig. 48A). Left spicule 0.402 long, with relatively blunt distal tip, and “slightly outlined” bifurcation (Fig. 48B). Right spicule 0.129 long, with dorsal barb at distal end (Fig. 48A). Length ratio of right to left spicule 1:3.12. Tail conical, 0.300 long, with sharp cuticular spike at tip.

Females (3 specimens): 10.91–12.10 long, 0.136–0.163 maximum width. Prostom funnel-shaped, 0.021–0.024 long, with distinct basal teeth, and 14 teeth projecting forwardly (Fig. 48C,D). Vestibule including prostom 0.111–0.138, muscular oesophagus 0.270–0.297, and glandular oesophagus 1.59–2.35 long. Medium sized bifurcate deirids 0.063–0.081, nerve ring 0.186–0.189, and excretory pore 0.261 from anterior end. Vulva slightly post-equatorial, 5.03–6.12 from posterior end. Eggs oval, 0.030–0.036 x 0.018–0.021. Surface of advanced eggs (containing larvae) smooth; poles provided with numerous fine filaments (Fig. 48E), those on one pole arranged mostly in parallel giving the appearance of a short ribbon-like filament with the end frayed (Fig. 48E, lower egg). Tail conical, 0.210–0.243 long, with sharp cuticular point.

Comment: Moravec & Arai (1971) stated that “in many important features *R. milleri* resembles *R. ovifilamenta*, and subsequent detailed studies might prove their conspecificity”.

Site: intestine

Hosts: *Carpiodes cyprinus* (7); *Moxostoma erythrurum* (2); *Moxostoma macrolepidotum* (1, 2, 6); *Oncorhynchus clarkii* (3); *Oncorhynchus mykiss* (3); *Prosopium coulterii* (3); *Prosopium williamsoni* (4, 5); *Rhinichthys cataractae* (4, 5); *Salvelinus fontinalis* (3); *Salvelinus malma* (3)

Distribution: Alberta, British Columbia, Ontario, Quebec

Records: 1. Choquette 1951a (QC); 2. Dechtiar 1972b (ON); 3. Mudry & Anderson 1977 (AB); 4. Anon. 1978 (BC); 5. Arai & Mudry 1983 (BC); 6. Dechtiar & Christie 1988 (ON); 7. Dechtiar & Nepszy 1988 (ON)

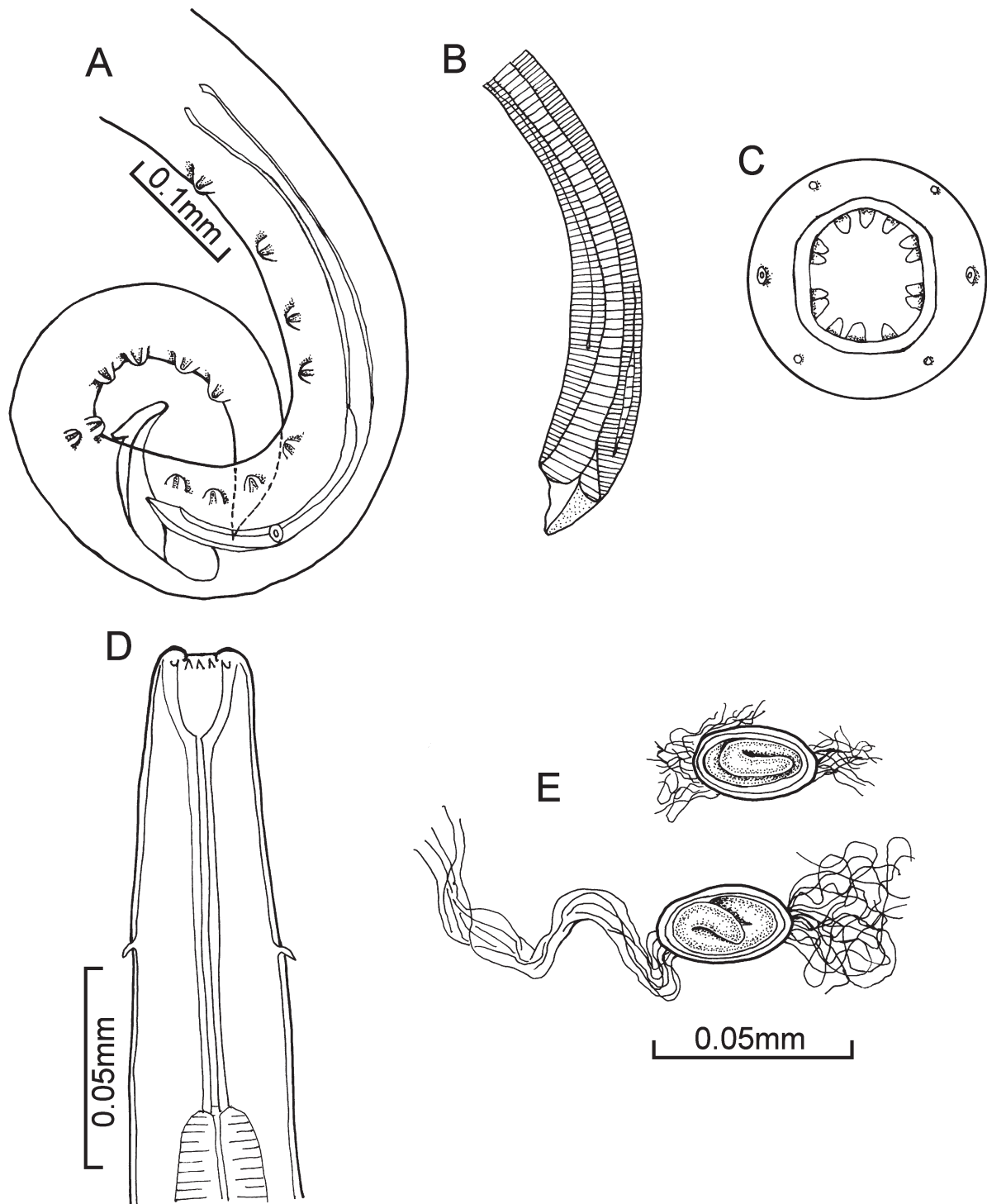


FIGURE 48. *Rhabdochona milleri* Choquette, 1951. A. male, posterior end, lateral view; B. left spicule, distal tip; C. female, *en face* view; D. female, anterior end; E. mature eggs. NB: scale bars were not provided in the original for either B. or C. (Redrawn from Moravec & Arai 1971)

***Rhabdochona ovifilamenta* Weller, 1938**

Synonyms: *Rhabdochona laurentiana* Lyster, 1940; *Rhabdochona fortunatowi* Dinnick, 1931 of Kussat (1969); *Rhabdochona* sp. of Arai & Kussat (1967)

Description (after Moravec & Arai 1971). With characteristics of the genus.

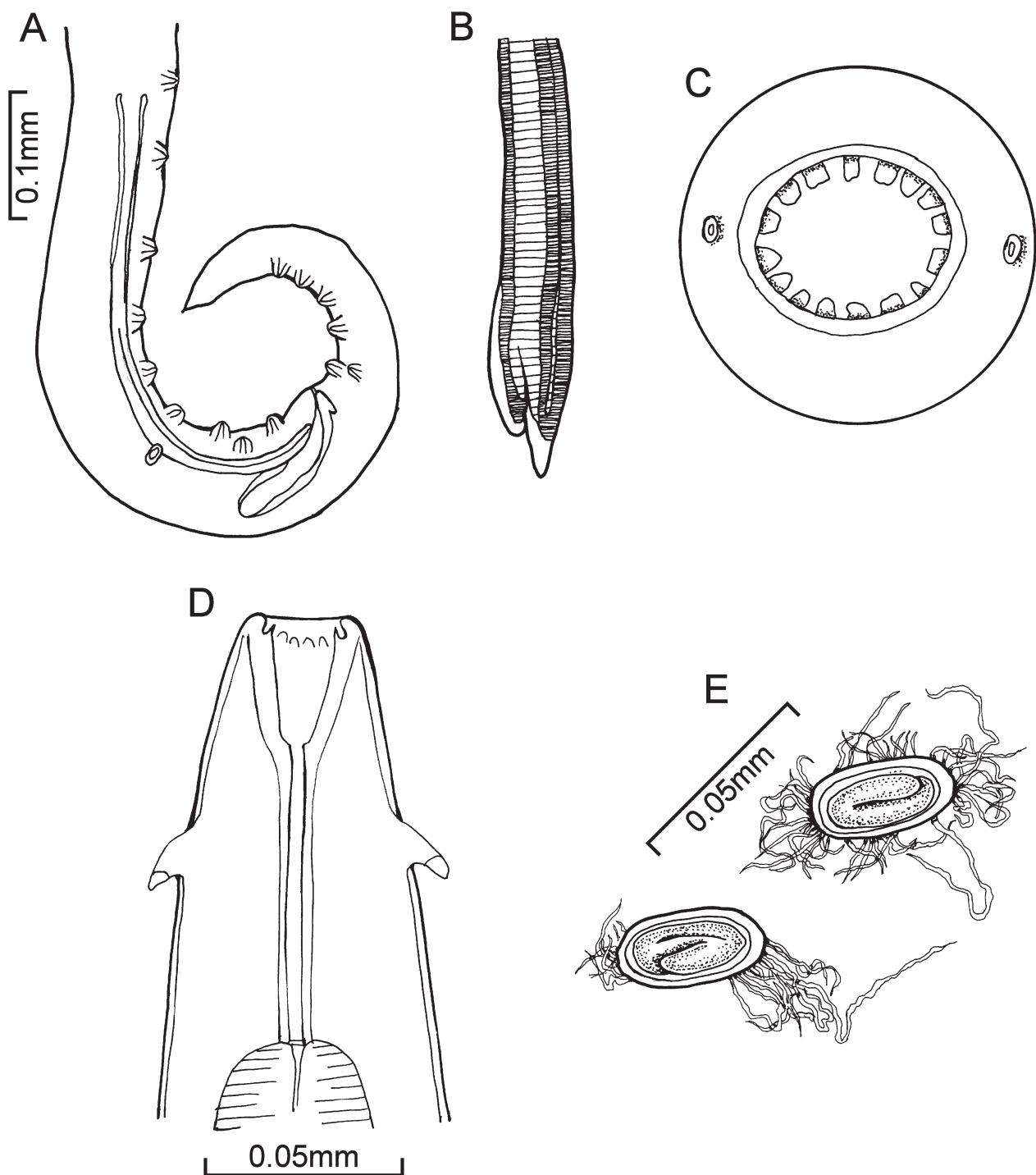


FIGURE 49. *Rhabdochona ovifilamenta* Weller, 1938. A. male, posterior end, lateral view; B. left spicule, distal tip; C. female, *en face* view; D. female, anterior end, dorsal view; E. mature eggs. NB: scale bars were not provided in the original for either B. or C. (Redrawn from Moravec & Arai 1971)

Males (three complete and three fragments): body 6.55–8.02 long, 0.095–0.136 maximum width. Pseudolabia rudimentary. Prostom relatively narrow, funnel-shaped, with indistinct basal teeth, lined internally with ribs forming forwardly projecting teeth (exact number not determined). Vestibule including prostom 0.111–0.138, muscular oesophagus 0.255–0.300, and glandular oesophagus 1.90–3.59 long. Relatively small bifurcate deirids 0.051–0.078, nerve ring 0.156–0.204, and excretory pore 0.237–0.264 from anterior end. Pairs of subventral pre-cloacal papillae variable in number: the following combinations were observed—6+7, 7+9, 8+9 and 9+10. Another pair was located laterally at level of 4th subventral pair. Six pairs of post-cloacal papillae present, the 2nd pair lateral,

the rest subventral (Fig. 49A). Left spicule 0.390–0.420 long, slender, with lanceolate distal tip, and “slightly outlined” bifurcation with fine cuticular membrane (Fig. 49B). Right spicule scoop-shaped, 0.105–0.117 long with reflected barb at tip. Length ratio of right to left spicule 1:3.52 to 1:3.78. Tail conical, 0.303–0.372 long, with distinct cuticular spike.

Females (three complete and two fragments): body 11.75–21.76 long, 0.204–0.258 maximum width. Pseudolabia rudimentary. Prostom thick-walled with distinct basal teeth, 0.030–0.039 long, and 16 teeth projecting forwardly (Fig. 49C). Vestibule including prostom 0.090–0.135, muscular oesophagus 0.276–0.558, and glandular oesophagus 1.60–4.42 long. Relatively large, “somewhat bifurcate” deirids 0.039–0.060 (Fig. 49D), nerve ring 0.126–0.210, and excretory pore 0.243 from anterior end. Vulva of younger females slightly pre-equatorial, in larger females distinctly post-equatorial, 6.23–8.98 from posterior end. Eggs oval, 0.036–0.042 x 0.018–0.021. Mature eggs embryonated. Entire surface covered with fine protuberances and numerous, short thread-like filaments (Fig. 49E); filaments distributed uniformly over entire surface of most eggs but, in some, filaments appear restricted to area near poles. Tail conical, 0.294–0.315 long, with short cuticular spike.

Comment: as already noted, Moravec & Arai (1971) suggested that *R. ovifilamenta* and *R. milleri* might be conspecific.

Site: intestine

Hosts: *Catostomus catostomus* (3, 4, 7); *Catostomus commersonii* (1, 8, 9, 11, 12); *Catostomus platyrhynchus* (4, 7, 8); *Perca flavescens* (5, 6, 10); *Salvelinus fontinalis* (2, 13)

Distribution: Alberta, Ontario, Quebec

Records: 1. Lyster 1940 (QC); 2. Choquette 1948a (QC); 3. Kussat 1966 (AB); 4. Arai & Kussat 1967 (AB); 5. Tedla & Fernando 1969a (ON); 6. Tedla 1969 (ON); 7. Kussat 1969 (AB); 8. Moravec & Arai 1971 (AB); 9. Dechtiar & Christie 1988 (ON); 10. Dechtiar & Lawrie 1988 (ON); 11. Dechtiar & Nepszy 1988 (ON); 12. Dechtiar *et al.* 1989 (ON); 13. Marcogliese & Cone 1991a (QC)

***Rhabdochona rotundicaudatum* Byrne, 1992**

Description (after Byrne 1992a). With characteristics of the genus. General characteristics: see those for *R. cascadiella* above.

Male paratypes (means with ranges in parentheses): body 5.8 (5.0–6.7), prostom 0.018 (0.017–0.023), vestibule 0.090 (0.081–0.100), muscular oesophagus 0.224 (0.188–0.251) and glandular oesophagus 1.6 (1.2–1.9) long. Small bifurcate deirids 0.051 (0.033–0.057), nerve ring 0.133 (0.127–0.137) and excretory pore 0.200 (0.195–0.208) from anterior end. Caudal papillae digitiform: 18 to 21 pre-cloacal and 11 to 13 post-cloacal, mostly subventral. Phasmids minute, located just distal to most posterior pair of caudal papillae. Left spicule 0.388 (0.342–0.421), its alate portion (blade) 0.183 (0.0159–0.196) long. Right spicule 0.092 (0.087–0.101) long, relatively stout, with dorsal projecting barb at distal end and a bulbous, convex proximal end (Fig. 50B). Length ratio of right to left spicule 1:3.93 to 1:4.22. Tail 0.306 (0.266–0.365) long, tapering and ending in a rounded tip (Fig. 50A).

Female paratypes (means with ranges in parentheses): body 10.6 (8.9–13.4), prostom 0.026 (0.023–0.028), vestibule 0.107 (0.097–0.120), muscular oesophagus 0.278 (0.261–0.290) and glandular oesophagus 2.27 (2.08–2.54) long. Deirids 0.066 (0.060–0.076), nerve ring 0.158 (0.146–0.179) and excretory pore 0.233 (0.212–0.265) from anterior end. Vulva located near midpoint of body, 6.0 (4.9–7.3) from anterior end. Phasmids minute, posterior to midpoint of tail. Eggs ovoid, smooth, without filaments or floats, 0.023 (0.023–0.024) x 0.038 (0.036–0.039). Tail 0.215 (0.188–0.241) long, tapering and ending in a rounded tip (Fig. 50C).

Note: Byrne (*op. cit.*) also provided measurements for the male holotype and female allotype of *R. rotundicaudatum*.

Site: intestine

Hosts: *Ambloplites rupestris* (1, 2); *Ameiurus nebulosus* (1, 2); *Etheostoma caeruleum* (1, 2); *Luxilus cornutus* (1, 2); *Nocomis biguttatus* (1, 2); *Nocomis micropogon* (2); *Semotilus atromaculatus* (1, 2)

Distribution: Ontario

Records: 1. Byrne 1992 a (ON); 2. Byrne 1992b (EX, ON)

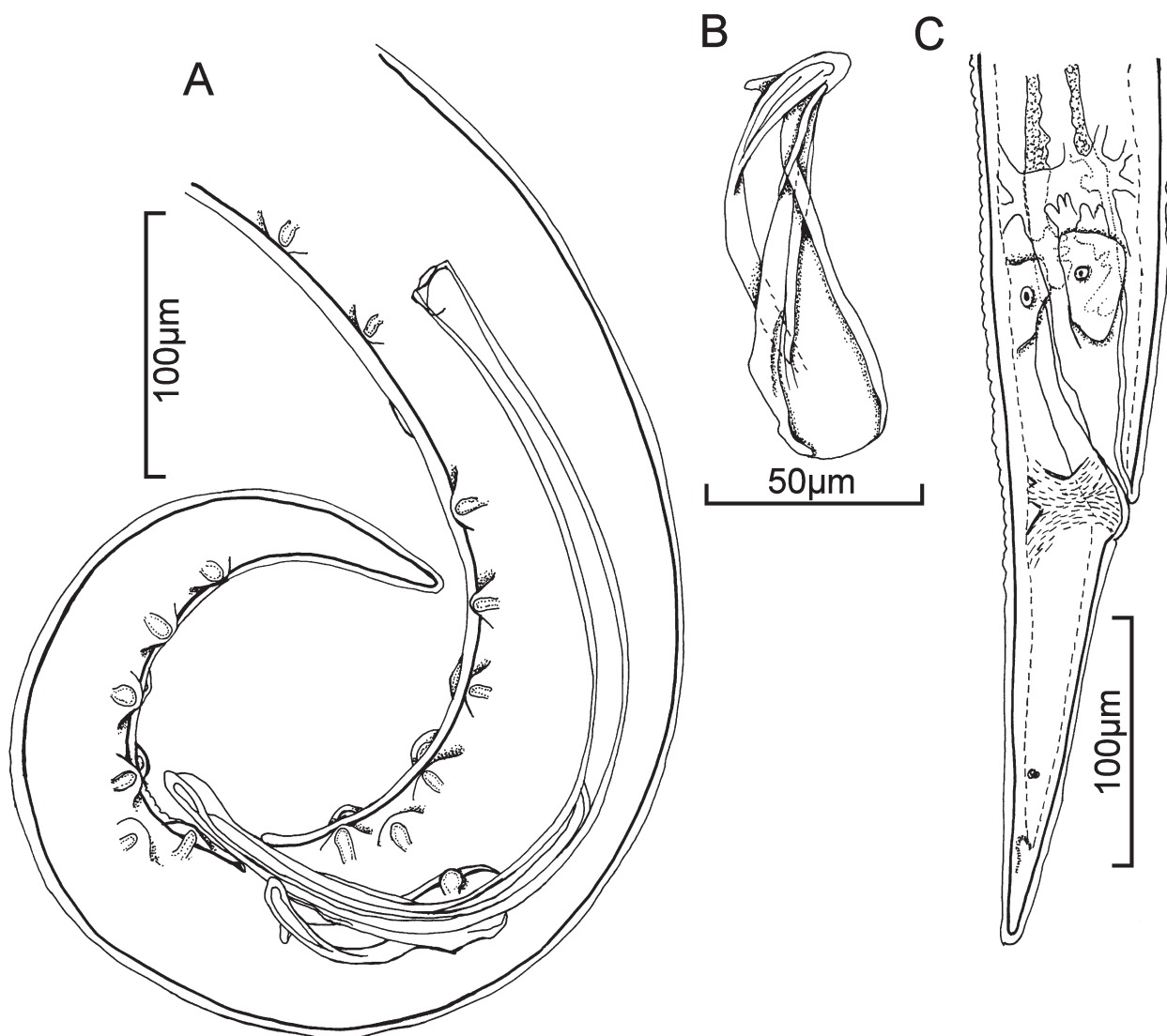


FIGURE 50. *Rhabdochona rotundicaudatum* Byrne, 1992. A. male, posterior end, lateral view; B. right spicule, lateral view; C. female, posterior end, lateral view. (Redrawn from Byrne 1992a)

***Rhabdochona zacconis* Yamaguti, 1935**

Description (after Moravec, Margolis & Boyce 1981). With characteristics of the genus. Medium-sized worms with smooth cuticle. Mouth approximately hexagonal, slightly compressed dorso-ventrally, surrounded by two large lateral amphids and four small sub-apical papillae. Prostom thick-walled, funnel-shaped, without basal teeth but with 14 teeth projecting anteriorly. Deirids medium-sized, bifurcate, located posterior to middle of vestibule (Fig. 51A). Tail of both sexes conical, ending in sharp point (Fig. 51B,E).

Males: body 6.69–10.06 long, 0.122–0.177 maximum width. Prostom 0.018–0.021, vestibule including prostom 0.135–0.207, muscular oesophagus 0.279–0.390 and glandular oesophagus 2.45–4.90 long. Deirids 0.075–0.090, nerve ring 0.192–0.237 and excretory pore 0.303 from anterior end. Pairs of subventral pre-cloacal papillae variable in number; the following combinations were observed: 7+8, 8+9 and 9+9. Another pair was located laterally at level of 3rd subventral pair. Six pairs of post-cloacal papillae present, the 2nd pair lateral, the rest subventral (Fig. 51B). Longitudinal ventral cuticular ridges anterior to pre-cloacal papillae well developed. Left spicule 0.435–0.510 long and 0.012–0.015 wide at mid-length, shaft representing its anterior half, with its distal tip moderately extended, provided with wide cuticular membrane forming large ventral process (Fig. 51C). Right spicule 0.108–0.120 long, boat-shaped, sometimes with dorsal barb on distal tip (Fig. 51D). Length ratio of right to left spicule 1:3.84 to 1:4.47. Tail conical, 0.354–0.411 long, its tip with sharp point (Fig. 51B).

Females: body 16.32–18.31 long, 0.245–0.285 maximum width. Prostom 0.030–0.033, vestibule including prostom 0.177–0.210, muscular oesophagus 0.450–0.525 and glandular oesophagus 4.15–5.98 long. Deirids 0.105–0.123, nerve ring 0.264–0.309 and excretory pore 0.414–0.453 from anterior end. Tail conical, 0.273–0.303 long, its tip with sharp point (Fig. 51E). Vulva post-equatorial, located 6.94–8.30 from posterior end. Eggs elongate-oval, 0.036–0.039 x 0.021. Each pole of mature eggs (containing larvae) with one, less frequently two, narrow filaments up to 0.57 long (Fig. 51F).

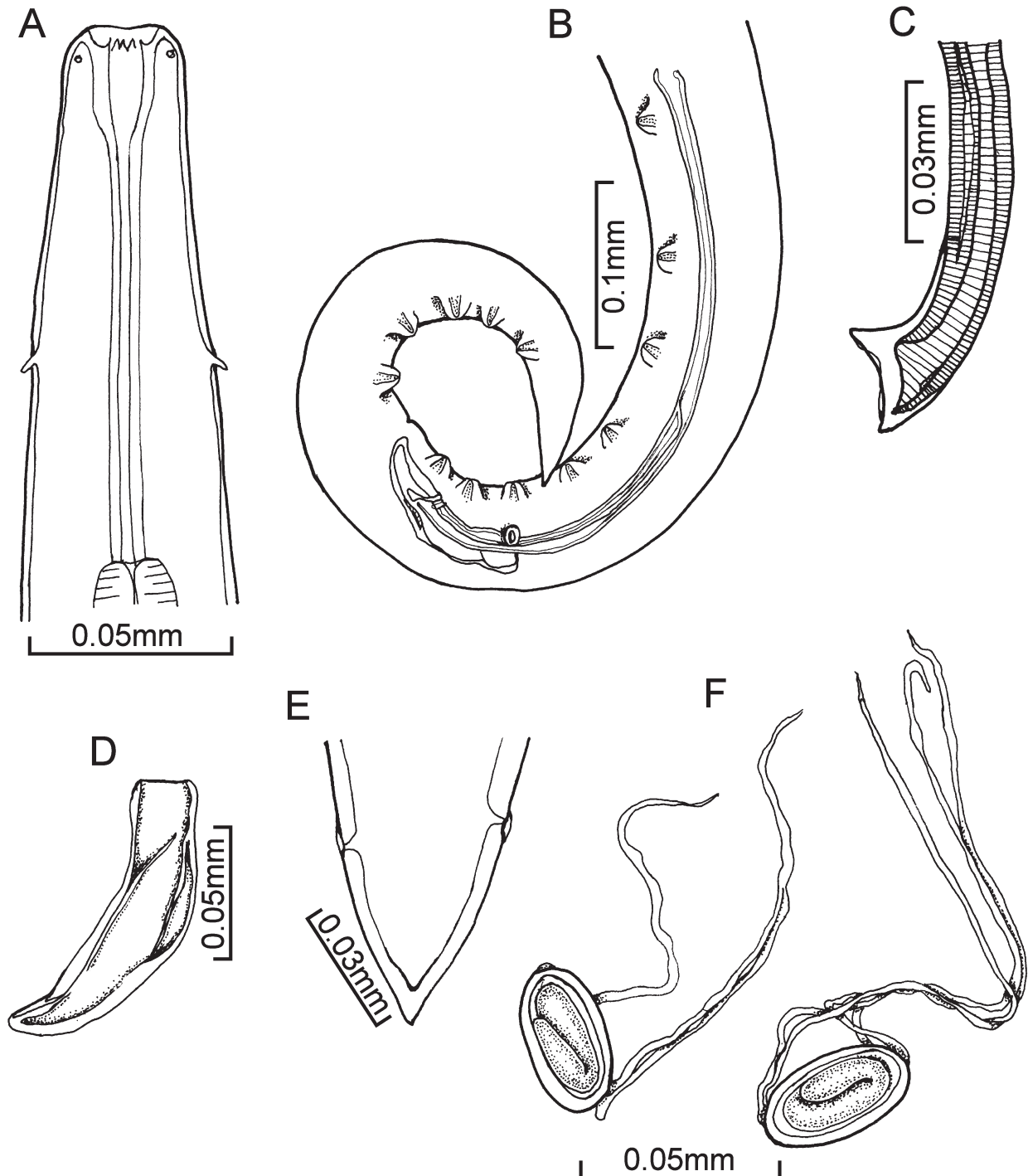


FIGURE 51. *Rhabdochona zacconis* Yamaguti, 1935. A. young female, anterior end, dorsal view; B. male, posterior end, lateral view; C. young male, left spicule, distal tip; D. young male, right spicule; E. female tail, dorsal view; F. eggs. (Redrawn from Moravec *et al.* 1981)

Site: intestine
Host: *Catostomus macrocheilus*
Distribution: British Columbia
Records: Anon. 1978; Arai & Mudry 1983

*****Rhabdochona* sp.**

Site: intestine
Hosts: *Ambloplites rupestris* (1, 17); *Ameiurus melas* (6); *Ameiurus nebulosus* (2, 21); *Catostomus catostomus* (9, 11, 14, 23); *Catostomus commersonii* (2, 3, 9); *Catostomus macrocheilus* (11, 14); *Coregonus clupeaformis* (3); *Cottus cognatus* (11, 14); *Couesius plumbeus* (5, 7); *Etheostoma caeruleum* (17, 21); *Etheostoma exile* (19); *Fundulus diaphanus* (1); *Lepomis gibbosus* (2, 3); *Lepomis macrochirus* (1); *Luxilus cornutus* (16, 20, 21); *Micropterus dolomieu* (6); *Morone chrysops* (1); *Mylocheilus caurinus* (14, 15); *Nocomis biguttatus* (21); *Notemigonus crysoleucas* (17, 20); *Notropis atherinoides* (21); *Notropis hudsonius* (4); *Oncorhynchus kisutch* (6, 13, 15); *Oncorhynchus mykiss* (11, 13, 14); *Oncorhynchus nerka* (8); *Oncorhynchus tshawytscha* (13, 14, 15); *Perca flavescens* (2, 5, 7, 10); *Percopsis omiscomaycus* (18); *Pimephales promelas* (3); *Prosopium williamsoni* (11, 13, 14, 15, 22); *Ptychocheilus oregonensis* (11, 14, 15); *Richardsonius balteatus* (11, 14); *Salvelinus fontinalis* (6); *Salvelinus fontinalis* x *Salvelinus namayacush* (12); *Salvelinus malma* (11, 13, 14, 15); *Semotilus atromaculatus* (21)

Distribution: Alberta, British Columbia, Labrador, Manitoba, Ontario

Records: 1. Bangham & Hunter 1939 (ON); 2. Bangham 1941 (ON); 3. Bangham & Venard 1946 (ON); 4. Stewart-Hay 1951c (MB); 5. Bangham 1951 (ON); 6. Bangham & Adams 1954 (BC); 7. Bangham 1955 (ON); 8. Margolis 1957 (BC); 9. Threlfall & Hanek 1970a (LB); 10. Mudry & Anderson 1977 (AB); 11. Anon. 1978 (BC); 12. Dechtiar & Berst 1978 (ON); 13. Anon. 1981 (BC); 14. Arai & Mudry 1983 (BC); 15. Anon. 1984 (BC); 16. Byrne & Baker 1987 (ON); 17. Dechtiar & Christie 1988 (ON); 18. Dechtiar & Lawrie 1988 (ON); 19. Dechtiar *et al.* 1988 (ON); 20. Dechtiar *et al.* 1989 (ON); 21. Byrne 1992b (ON); 22. Nener *et al.* 1995 (BC); 23. Baldwin & Goater 2003 (AB)

***Rhabdochonidae* gen. sp.**

Site: intestine
Host: *Acipenser fulvescens*
Distribution: Saskatchewan
Record: Choudhury *et al.* 1990

Superfamily SPIRUROIDEA Orley, 1885

Preamble: None of the following records of spiruroids in Canadian fishes is supported by a description or illustration.

****Spirurida* gen. sp.**

Sites: intestinal wall, mesenteries, stomach wall
Hosts: *Acipenser transmontanus* (7); *Atheresthes stomias* (6); *Clupea pallasii* (2, 3); *Hippoglossus stenolepis* (9, 10, 11); *Mallotus villosus* (8); *Microstomus pacificus* (6); *Oncorhynchus mykiss* (4); *Theragra chalcogramma* (5, 6); unspecified “fish” (1)
Distribution: Atlantic, British Columbia, Pacific
Records: 1. Boyce 1971 (PA); 2. Arthur 1978 (PA); 3. Arthur & Arai 1980a (PA); 4. Anon. 1984 (BC); 5. Arthur 1984 (PA); 6. Kabata & Whitaker 1984 (PA); 7. Margolis & McDonald 1986 (BC); 8. Arthur *et al.* 1985 (AT); 9. Blaycock 1996 (PA); 10. Blaycock *et al.* 1998a (PA); 11. Blaycock *et al.* 1998b (PA)

***Spiruridae gen. sp.**

Site: body cavity

Hosts: *Hippoglossus stenolepis* (2, 3, 4, 5); unspecified “fish” (1)

Distribution: Pacific

Records: 1. Boyce 1971; 2. Blaycock 1996; 3. Blaycock *et al.* 1998a; 4. Blaycock *et al.* 1998b; 5. Blaycock *et al.* 2003

***Spirurinae gen. sp.**

Site: mesenteries

Host: *Myoxocephalus thompsonii*

Distribution: Ontario

Record: Black & Lankester 1981b

***Spiruroidea gen. sp.**

Sites: body cavity, mesenteries, musculature

Host: *Acipenser transmontanus*

Distribution: British Columbia

Record: Margolis & McDonald 1986

Superfamily HABRONEMATOIDEA Chitwood and Wehr, 1932

Preamble: Representatives of the following Families of habronematoids have been reported from Canadian fishes: Cystidicolidae, Hedruridae and Tetrameridae. Of these Families, however, representatives of only the Cystidicolidae have been adequately described and illustrated. Records of larval *Hedruris* sp. (Hedruridae) and of larval *Tetrameres* sp. (Tetrameridae) are included below for the sake of completeness but neither record can be verified in the absence of descriptions or illustrations. In these circumstances, design of a key to the Families of habronematoids would be superfluous.

Family CYSTIDICOLIDAE Skryabin, 1946

Family diagnosis (after Moravec 2013). Large or medium sized worms. Cuticle sometimes ornamented. Mouth opening slit-like or dorso-ventrally elongated. Pseudolabia large or small, sometimes much reduced. Cephalic papillae usually reduced to four at base of pseudolabia. Anterior end of buccal cavity sometimes armed with small teeth. Oesophagus usually divided into anterior muscular and posterior glandular portions. Caudal alae present in males. Eggs oval, larvated, sometimes with special surface ornamentations. Parasites of alimentary tract and swim bladder of fishes.

Comments: Moravec (2007) pointed out that erection of several cystidicolid genera has been based on the fine details of cephalic structures that are visible only with the aid of scanning electron microscopy (SEM). The generic importance of these minute features must await examination by SEM of more cystidicolids and the availability of further comparative molecular data. However, such developments may be irrelevant to users of this part of the Guide.

Key to genera of CYSTIDICOLIDAE

- 1 Cuticular ornamentation in form of transverse rings with spines; parasitic in alimentary tract of fishes, generally freshwater . .
 *Spinitectus*

-	Cuticular ornamentation, if present, never in form of transverse rings with spines; parasitic in alimentary tract or swim bladder of fishes	2
2	Four pairs of pre-cloacal papillae in male	3
-	Six or more pairs of pre-cloacal papillae in male	5
3	Bidentate plate-like structure arising from antero-lateral wall of buccal cavity present; anterior margin of pseudolabia forming narrow ridge; parasitic in alimentary tract of fishes, mostly sturgeons.	<i>Capillospirura</i>
-	Bidentate plate-like structure arising from antero-lateral wall of buccal cavity absent; pseudolabia narrow or broad	4
4	Pseudolabia very broad and flat; anterior surface of each pseudolabium with small protuberance (pseudolabial protrusion); submedian labia absent	<i>Salmonema</i>
-	Buccal cavity dilated anteriorly forming buccal capsule divided into ventral and dorsal chambers; parasitic in swim bladder of salmonid fishes	<i>Salvelinema</i>
5	Pseudolabia narrow: anterior extension of each lateral wall of buccal cavity projecting beyond junction with pseudolabium in a two-pronged horn-like structure, prongs of each projection lying on either side of pseudolabium	<i>Caballeronema</i>
- P	seudolabia narrow: horn-like structures absent; anterior surface of each pseudolabium with a prominent conical protuberance or a blunt knob; four submedian labia present	<i>Ascarophis</i>
6	Anterior margin of vestibule armed with two rows of denticles; pseudolabia rudimentary, each forming small, conical, anteriorly protruding structure; 12 to 18 pairs of pre-cloacal papillae in male; parasitic in swim bladder of salmonid fishes	<i>Cystidicola</i>

Comments: Moravec *et al.* (2008) considered *Sterliadochona* Skryabin, 1948 to be a *genus inquirendum*. The genus *Salmonema* Moravec, Santos & Brasil-Sato, 2008, was erected with type species *Salmonema ephemeridarum* (Linstow, 1872) and *S. prevosti* (Choquette, 1951).

***Ascarophis* van Beneden, 1871**

Synonym: *Pseudocystidicola* Layman, 1933

Generic diagnosis (after Moravec 2013). Cystidicolidae. Small to medium sized worms. Pseudolabia continuous medially with anterior extensions of lateral walls of buccal cavity; anterior surface of each pseudolabium with prominent conical protuberance or blunt knob. Flap-like or bilobed sublabium along inner margin of each submedian labium. Four cephalic papillae. Mouth opening dorso-ventrally elongated, with four lateral recesses. Deirids simple, small. Male with pre-cloacal cuticular ridges (an *area rugosa*). Male caudal alae well developed supported by pedunculate papillae. Spicules unequal and dissimilar. Female tail ends bluntly or with knob-like structure. Uterus amphidelphic. Vulva equatorial or postequatorial. Eggs elliptical, embryonated, with or without polar filaments. Parasitic in alimentary tract of fishes.

Key to species of *Ascarophis*

1	Tufts of filaments on both poles of eggs; left spicule 0.59–0.88 long	<i>A. arctica</i>
-	Filaments on only one egg pole.	2
2	Left spicule < 0.15 long. Females 7.1– 9.4 long	<i>A. Sebastodis</i>
-	Left spicule > 0.50 long. Females 8.5–12.7 long	<i>A. morrhuae</i>
3	Left spicule between 0.25 and 0.40 long	4
4	Females 5.9–8.7 long	<i>A. extalicola</i>
-	Females 19.3–35.9 long	<i>A. filiformis</i>

***Ascarophis arctica* Polyanski, 1952**

Description (after Appy 1981). With characteristics of the genus.

Males: 6.6 (5.7–7.9) long, 0.089 (0.062–0.105) wide at *vas deferens*. Muscular oesophagus 0.274 (0.233–0.325) and glandular oesophagus 1.650 (1.325–2.045) long. Deirids, nerve ring and excretory pore 0.132 (0.110–0.151), 0.179 (0.155–0.202) and 0.267 (0.232–0.338), respectively, from anterior end (Fig. 52A). Tail 0.151 (0.129–0.182) long. Right spicule 0.100 (0.085–0.111) long, spicule arcuate, notched distally. Left spicule 0.808 (0.585–0.882) long, tubular, divided into proximal shaft and blade. Ratio of left to right 1:8.1 (1:5.9 to 1:10.4).

Area rugosa with about 14 longitudinal rows of cuticular elevations. Ten pairs caudal papillae: two double pairs pre-cloacal, six pairs post-cloacal; 5th post-cloacal pair relatively small, ventral to 6th pair. Caudal alae narrow. Phasmids immediately behind last pair post-cloacal papillae (Fig. 52B).

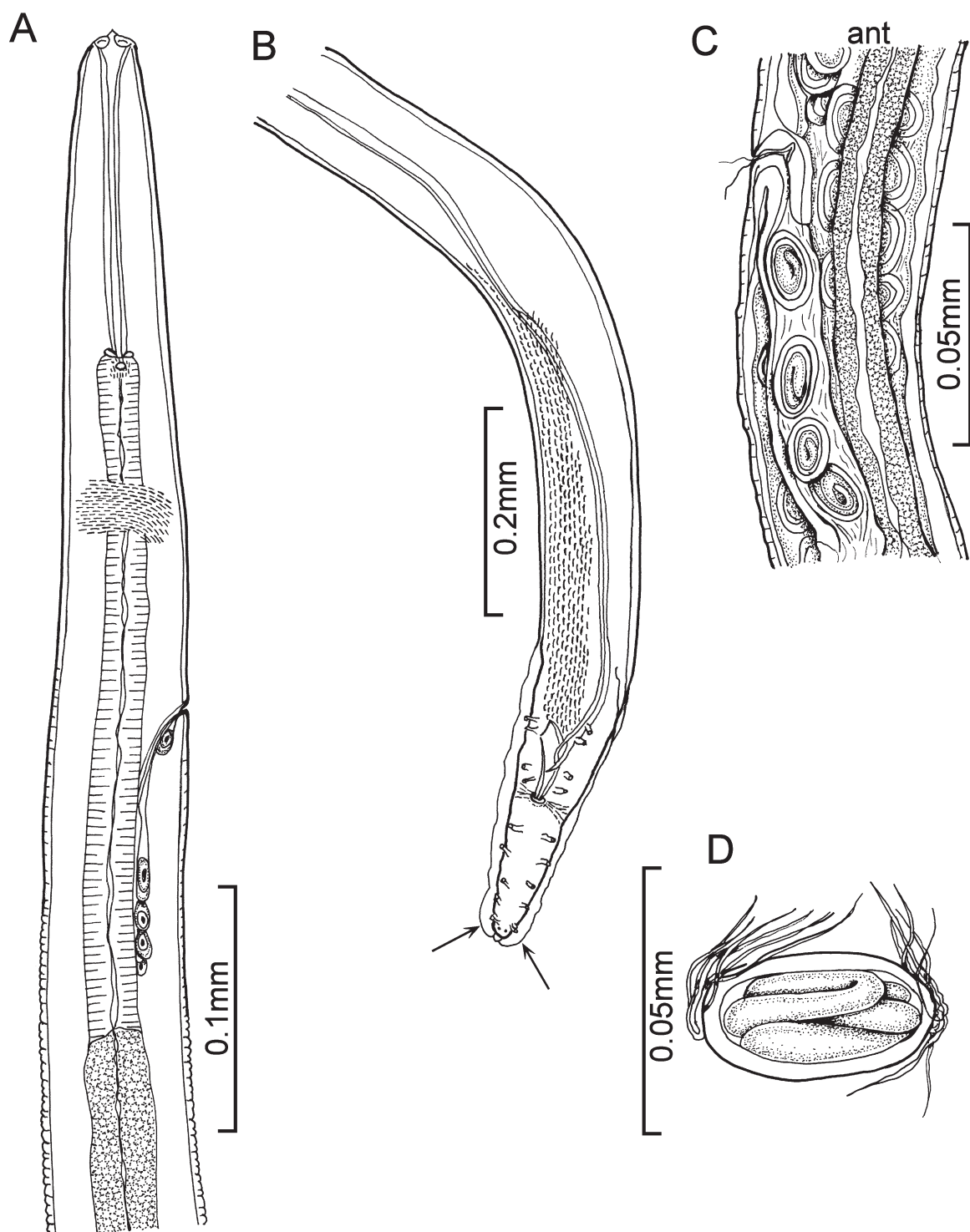


FIGURE 52. *Ascarophis arctica* Polyanski, 1952. A. male, anterior end, lateral view; B. male, posterior end, ventral view, arrows indicate the 5th and 6th pairs of post-caudal papillae; C. female, vulvar region, lateral view [NB: for presentational reasons, polar filaments have been omitted from *in utero* eggs to avoid clutter]; D. egg from uterus. (Redrawn from Appy 1981)

Females: 13.3 (10.5–15.4) long, 0.124 (0.092–0.157) wide at vulva. Muscular oesophagus 0.321 (0.235–0.414) and glandular oesophagus 1.928 (1.474–2.554) long. Deirids, nerve ring, excretory pore and vulva 0.147 (0.131–0.166), 0.194 (0.172–0.221), 0.295 (0.269–0.338) and 7.0 (5.5–8.3), respectively, from anterior end (Fig. 52C). [NB: to avoid clutter in Figure 52C the *in utero* eggs have been drawn as if they lack polar filaments.] Tail 0.052 (0.034–0.071) long. Eggs 0.045 (0.043–0.048) x 0.024 (0.022–0.027) with filaments at both poles (Fig. 52D).

[For comments on *A. arctica* see page 90–91]

Sites: alimentary tract, stomach

Hosts: *Gadus morhua* (1, 3); *Hemitripterus americanus* (1); *Hippoglossoides platessoides* (5); *Melanogrammus aeglefinus* (1, 2, 4); *Merluccius bilinearis* (1); *Microgadus tomcod* (1); *Osmerus mordax* (1); *Pholis gunnellus* (1); *Pseudopleuronectes americanus* (1, 7); *Reinhardtius hippoglossoides* (6); *Urophycis tenuis* (1); *Zoarces americanus* (1)

Distribution: Atlantic

Records: 1. Appy 1981; 2. Scott 1981; 3. Appy & Burt 1982; 4. Scott 1982; 5. Zubchenko 1985a; 6. Arthur & Albert 1994; 7. McClelland *et al.* 2005

***Ascarophis extalicola* Appy, 1981**

Description (after Appy 1981). With characteristics of the genus.

Males: 5.3 (4.0–6.3) long, 0.039 (0.033–0.051) wide at *vas deferens*. Muscular oesophagus 0.184 (0.159–0.224) and glandular oesophagus 1.018 (0.732–1.269) long. Deirids, nerve ring and excretory pore 0.113 (0.097–0.127), 0.134 (0.116–0.148) and 0.212 (0.183–0.244), respectively, from anterior end (Fig. 53A). Tail 0.098 (0.078–0.117) long. Right spicule 0.070 (0.061–0.083) long, spicule arcuate, notched distally. Left spicule 0.313 (0.276–0.359) long, divided into proximal shaft and blade. Ratio of left to right 1:4.5 (1:3.6 to 1:5.6). *Area rugosa* with about nine longitudinal rows of cuticular elevations. 10 pairs caudal papillae: four pairs pre-cloacal, six pairs post-cloacal; 5th post-cloacal pair relatively small, ventral to 6th pair. Caudal alae narrow. Phasmids behind last pair of post-cloacal papillae (Fig. 53B).

Females: 7.2 (5.9–8.7) long, 0.050 (0.037–0.072) wide at vulva. Muscular oesophagus 0.187 (0.163–0.202) and glandular oesophagus 1.196 (1.015–1.363) long. Deirids, nerve ring, excretory pore and vulva 0.115 (0.101–0.128), 0.133 (0.116–0.148), 0.215 (0.180–0.237) and 5.2 (4.2–6.2), respectively, from anterior end. Tail 0.052 (0.037–0.066) long (Fig. 53C). Eggs 0.044 (0.041–0.046) x 0.027 (0.026–0.031) with two to 11 filaments at one pole (Fig. 53D).

[For comments on *A. extalicola* see pages 90–91.]

Sites: intestine, rectum

Hosts: *Gadus morhua* (1, 3); *Melanogrammus aeglefinus* (2); *Myoxocephalus octodecemspinosus* (1)

Distribution: Atlantic

Records: 1. Appy 1981; 2. Scott 1981; 3. Appy & Burt 1982

***Ascarophis filiformis* Polyanski, 1952**

Description (after Appy 1981). With characteristics of the genus.

Males: 12.4 (9.0–14.7) long, 0.105 (0.077–0.130) wide at *vas deferens*. Muscular oesophagus 0.343 (0.260–0.403) and glandular oesophagus 2.117 (1.445–2.864) long. Deirids, nerve ring and excretory pore 0.175 (0.140–0.209), 0.219 (0.185–0.258) and 0.325 (0.264–0.367), respectively, from anterior end (Fig. 54A). Tail 0.158 (0.125–0.189) long. Right spicule 0.109 (0.094–0.129) long, spicule arcuate, notched distally. Left spicule 0.328 (0.271–0.392) long, tubular, divided into proximal shaft and blade. Ratio of left to right 1:3.0 (1:2.5 to 1:3.5). *Area rugosa* with about 11 longitudinal rows of cuticular elevations. 10 pairs caudal papillae: two double pairs pre-cloacal, six pairs post-cloacal; 5th post-cloacal pair relatively small, ventral to 6th pair. Caudal alae narrow. Phasmids behind last pair post-cloacal papillae (Fig. 54B).

Females: 25.1 (19.3–35.9) long, 0.160 (0.112–0.207) wide at vulva. Muscular oesophagus 0.386 (0.330–0.462) and glandular oesophagus 2.606 (1.845–3.424) long. Deirids, nerve ring, excretory pore and vulva 0.186 (0.143–

0.228), 0.228 (0.179–0.265), 0.340 (0.258–0.415) and 12.7 (9.5–18.3), respectively, from anterior end. Tail 0.090 (0.058–0.120) long (Fig. 54C). Eggs 0.047 (0.042–0.050) x 0.031 (0.028–0.035) with two filaments arising from prominent knob at one pole (Fig. 54D).

[For comments on *A. filiformis* see page 90–91]

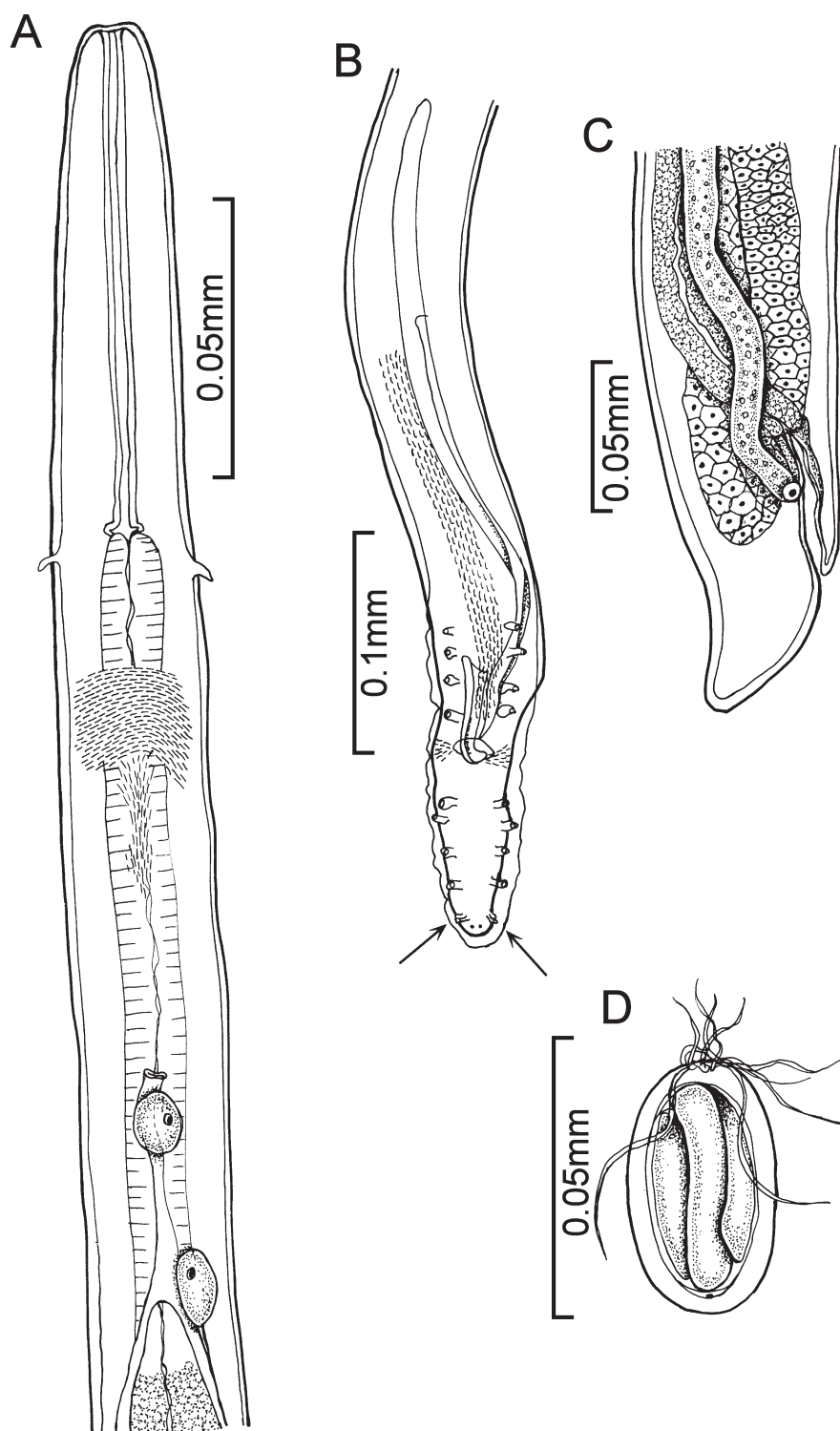


FIGURE 53. *Ascarophis extalicola* Appy, 1981. A. female, anterior end, ventral view; B. male, posterior end, ventral view, arrows indicate the 5th and 6th pairs of post-caudal papillae; C. female, posterior end, lateral view; D. egg from uterus. (Redrawn from Appy 1981)

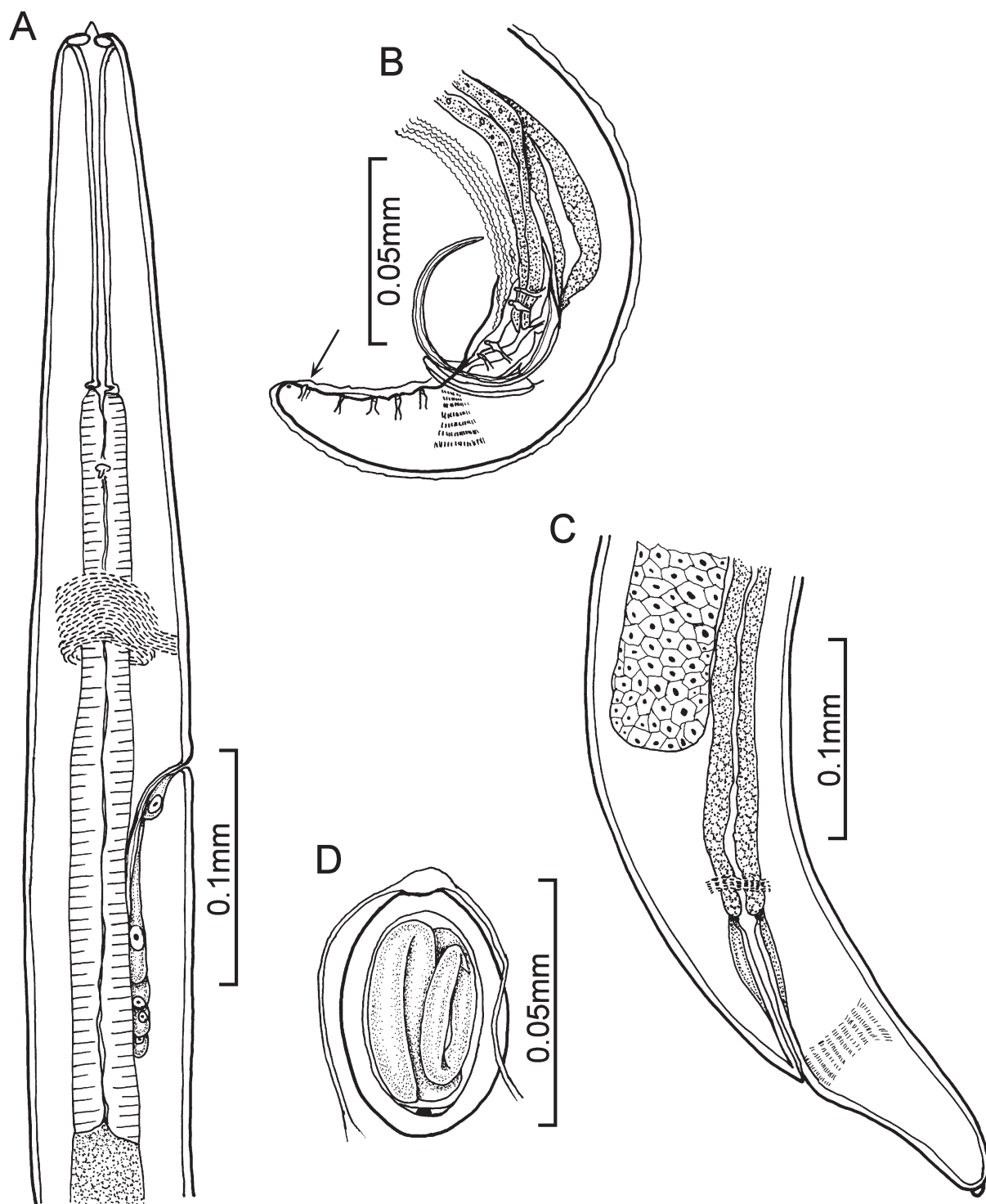


FIGURE 54. *Ascarophis filiformis* Polyanski, 1952. A. male, anterior end, lateral view; B. male, posterior end, lateral view, arrow indicates left-hand pair 5th and 6th post-caudal papillae; C. female, posterior end, lateral view; D. egg from uterus. (Redrawn from Appy 1981)

Site: stomach

Hosts: *Boreogadus saida* (9); *Gadus morhua* (1, 2, 3, 4); *Hippoglossus stenolepis* (7, 8); *Liparis dennyi* (5); *Reinhardtius hippoglossoides* (6)

Distribution: Atlantic, Nunavut, Pacific

Records: 1. Redkozubova 1976 (AT); 2. Linkletter *et al.* 1977 (AT); 3. Appy 1981 (AT); 4. Appy & Burt 1982 (AT); 5. Ko 1986 (PA); 6. Arthur & Albert 1994 (AT); 7. Blaycock 1996 (PA); 8. Blaycock *et al.* 1998a (PA); Koie 2009 (NU)

Ascarophis morrhuae van Beneden, 1871

Description (after Ko 1986). With characteristics of the genus.

Males: 5.9 (5.1–7.2) long, 0.028 (0.026–0.029) wide at nerve ring. Buccal cavity 0.097 (0.086–0.108) long (Fig. 55A). Muscular oesophagus 0.271 (0.226–0.297) and glandular oesophagus 1.75 (1.34–2.43) long. Nerve ring 0.134 and excretory pore 0.242 from anterior end. Four pairs pre-cloacal, and six pairs post-cloacal papillae. Left spicule 0.765 (0.740–0.790), right spicule 0.098 (0.095–0.100) long (Fig. 55B). Tail 0.105 (0.084–0.134) long.

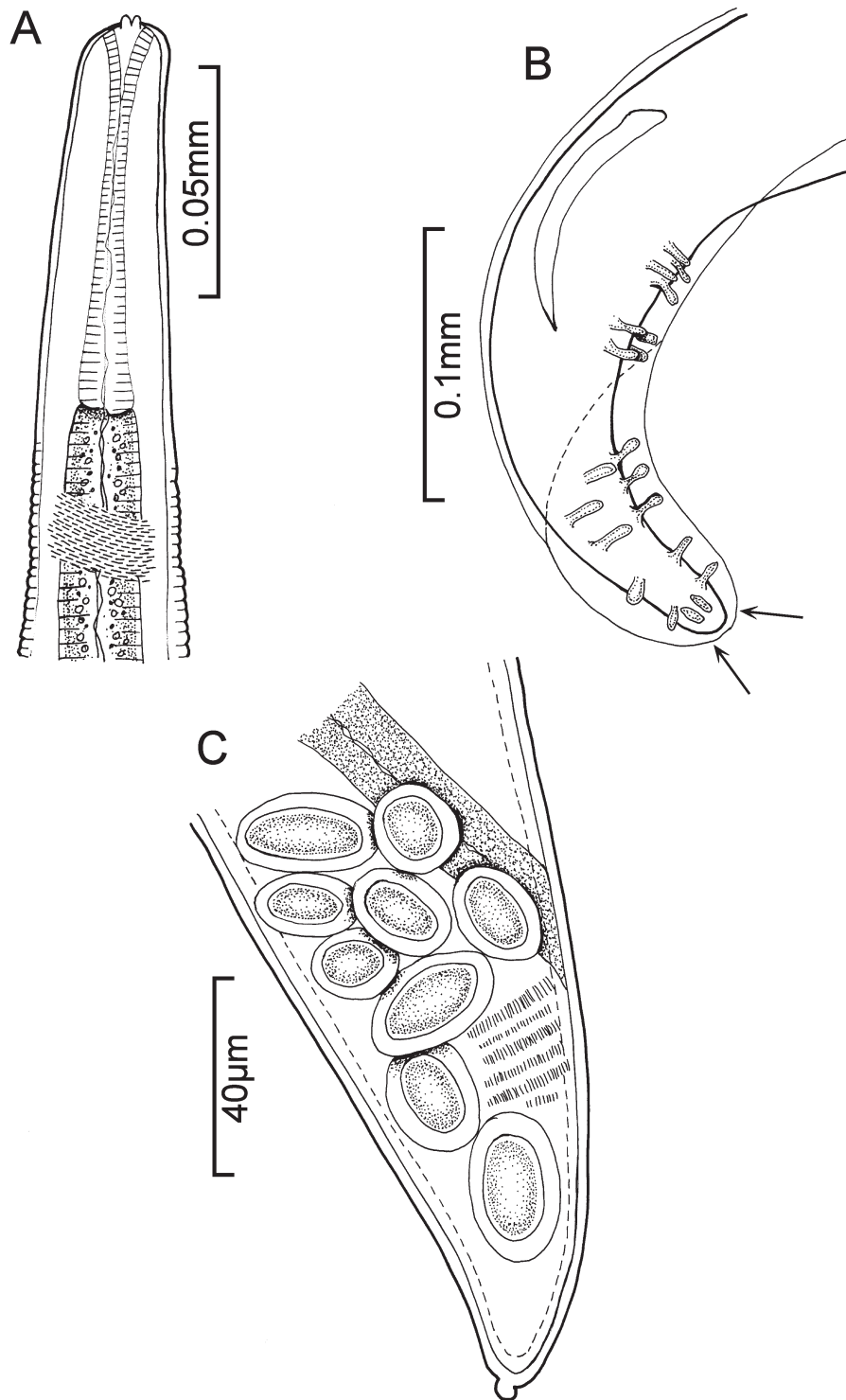


FIGURE 55. *Ascarophis morrhuae* van Beneden, 1871. A. anterior end, lateral view; B. male, posterior end with short (right) spicule, arrows indicate structures that are “possibly the phasmids” [*sic*]; C. female, posterior end showing extent of uterus, eggs evidently lacking polar filaments. (A. and B. redrawn from Berland 1961; C. redrawn from Ko 1986)

Females: 10.8 (8.5–12.7) long, 0.036 (0.031–0.041) wide at nerve ring. Buccal cavity 0.098 (0.085–0.115) long. Muscular oesophagus 0.246 (0.216–0.288) and glandular oesophagus 1.9 (1.1–2.3) long. Nerve ring 0.140 (0.113–0.178) and excretory pore 0.212 (0.161–0.240) from anterior end. Vulva 5.3 (4.7–6.0) from posterior end. Uterus extends from region of glandular oesophagus almost to tail tip. Tail 0.116 (0.072–0.146) long with knob-like tip (Fig. 55C). Embryonated eggs 0.036 (0.026–0.046) x 0.024 (0.022–0.026) with one polar plug bearing two filaments although, according to Ko (1986), eggs in the posterior extension of the uterus apparently lack filaments (Fig. 55C).

[For comments on *A. morrhuae* see below]

Site: alimentary tract

Hosts: *Alosa sapidissima* (4); *Anarhichas lupus* (3); *Gadus morhua* (2); *Gasterosteus aculeatus* (1); *Glyptocephalus cynoglossus* (3)

Distribution: Atlantic, Labrador, Newfoundland

Records: 1. Hanek & Threlfall 1970a (AT, LB, NL); 2. Gaevskaya & Umnova 1977 (AT); 3. Zubchenko 1980 (AT); 4. Hogans *et al.* 1993 (AT)

***Ascarophis Sebastodis* Olsen, 1952**

Description (after Ko 1986). With characteristics of the genus.

Males: 5.1 (3.7–6.4) long, 0.026 (0.020–0.030) wide at nerve ring. Buccal cavity 0.080 (0.070–0.100), muscular oesophagus 0.282 (0.220–0.377) and glandular oesophagus 2.5 (1.7–2.5) long. Nerve ring 0.117 (0.090–0.144) from anterior end (Fig. 56A). Four pairs pre-cloacal and six pairs post-cloacal papillae. Left spicule 0.135 and right spicule 0.047 (0.036–0.053) long. Tail 0.065 (0.053–0.074) long.

Females: 8.7 (7.1–9.4) long, 0.028 (0.022–0.030) at nerve ring. Buccal cavity 0.086 (0.080–0.090), muscular oesophagus 0.374 (0.310–0.410) and glandular oesophagus 2.5 (1.8–2.9) long. Nerve ring 0.136 (0.115–0.144) from anterior end. Vulva 2.2 from posterior end. Tail 0.055 (0.041–0.070) long, ending in small knob (Fig. 56B). Eggs 0.037 (0.036–0.038) x 0.023 (0.019–0.024) with polar plug bearing two filaments (Fig. 56C).

[For comments on *A. Sebastodis* see below]

Site: intestinal lumen

Hosts: *Anoplarchus purpureus* (1); *Artedius harringtoni* (1); *Aulorhynchus flavidus* (1); *Hemilepidotus hemilepidotus* (1); *Hexagrammos lagocephalus* (1); *Microstomus pacificus* (3); *Myoxocephalus polyacanthocephalus* (1); *Nautichthys oculofasciatus* (1); *Oncorhynchus kisutch* (1, 4); *Oncorhynchus nerka* (1); *Parophrys vetulus* (3); *Rhamphocottus richardsonii* (1); *Sebastes alutus* (2); *Sebastes borealis* (2); *Sebastes caurinus* (1, 2, 4); *Sebastes diploproa* (2); *Sebastes variegatus* (1, 2); *Sebastes flavidus* (2); *Sebastes maliger* (2); *Sebastes nebulosus* (5); *Sebastes proriger* (2); *Sebastes ruberrimus* (2); *Sebastes variegatus* (2); *Sebastes zacentrus* (2)

Distribution: Pacific

Records: 1. Arai 1969; 2. Sekerak & Arai 1977; 3. Kabata & Whitaker 1984; 4. Ko 1986; 5. Holmes 1990

***Ascarophis* sp.**

Sites: intestinal lumen, stomach

Hosts: *Coregonus nasus* (8); *Cottus aleuticus* (5); *Gadus macrocephalus* (5); *Gadus morhua* (9); *Hexagrammos decagrammus* (1, 5); *Mallotus villosus* (6); *Nautichthys oculofasciatus* (5); *Oncorhynchus gorbuscha* (2, 4); *Reinhardtius hippoglossoides* (7)

Distribution: Atlantic, British Columbia, Newfoundland, Northwest Territories, Pacific

Records: 1. Margolis 1977 (PA); 2. Anon. 1981 (BC); 3. Sankurathri *et al.* 1983 (PA); 4. Anon. 1984 (BC); 5. Ko 1986 (BC, PA); 6. Arthur *et al.* 1995 (AT); 7. Boje *et al.* 1997 (AT); 8. Choudhury & Dick 1997 (NT); 9. Khan *et al.* 2011 (NF)

Comments: Five *Ascarophis* species are known currently from Canadian fishes. Appy (1981) provided good descriptions and illustrations for *A. arctica*, *A. extalicola* and *A. filiformis*; the original descriptions of *A. morrhuae* and *A. Sebastodis* are relatively poor. Taxonomic problems concern morphology of the head of both sexes, and the tails of males. Regarding the head, the pseudolabia of *A. extalicola* have a blunt knob rather than the prominent

conical apex of *A. arctica* and *A. filiformis*, so Appy (*op. cit.*) and Ko (1986) suggested that *A. extalicola* might be related to “*Cystidicoloides*” [species of which have been transferred to *Salmonema*; see page 100]. Regarding male tails, an *area rugosa*, narrow caudal alae, six pairs of post-cloacal papillae, and paired phasmids behind the 6th pair of papillae appear to be diagnostic. Appy (*op. cit.*) pointed out that papillae of the 5th pair are relatively small and ventral to the 6th pair, so earlier workers might have overlooked them. Indeed, Figure 55B illustrates an *A. morrhuae* male, redrawn from Berland (1961), apparently with only five pairs of post-cloacal papillae, and structures that are [*sic*] “possibly the phasmids”. The description of neither *A. morrhuae* nor *A. Sebastodis* mentions an *area rugosa*; there is no reference to paired phasmids for *A. Sebastodis*; and caudal alae are not mentioned in the descriptions for either species, although Figure 55B illustrates them for *A. morrhuae*. Both *A. morrhuae* and *A. Sebastodis* should be redescribed and illustrated with special attention to the morphology of heads and tails.

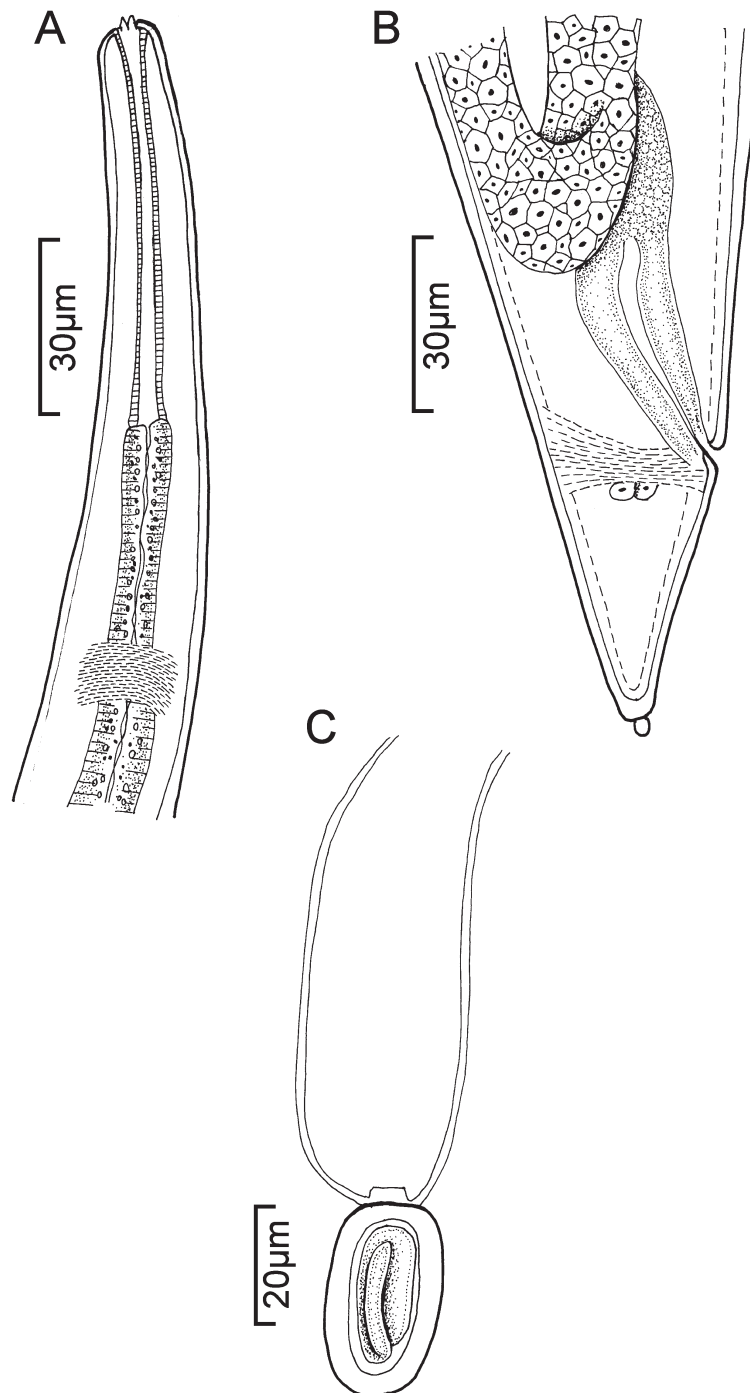


FIGURE 56. *Ascarophis Sebastodis* Olsen, 1952. A. male, anterior end, lateral view; B. female, posterior end, lateral view; C. egg showing two polar filaments. (Redrawn from Ko 1986).

***Caballeronema* Margolis, 1977**

Generic diagnosis (after Margolis 1977). Cystidicolidae. Relatively large worms, tapering at both ends, cuticle transversely striated. Mouth dorso-ventrally elongated, surrounded by four submedian labia (two subdorsal and two subventral) and two narrow lateral pseudolabia; bilobed structure (sublabium), with thickened free margin, attached by its base to inner surface of each labium; pseudolabia continuous on inner margin with lateral anterior extensions of buccal cavity wall; these extensions terminating in two-pronged horn-like projections, prongs lying on either side of corresponding pseudolabium. of each projection. Four submedian cephalic papillae and two lateral amphids. Buccal cavity with thick cuticularized walls, sigmoid, longer than broad. Oesophagus divided into short anterior muscular and long posterior glandular portions. Nerve ring and excretory pore at level of muscular oesophagus. Caudal end of male spirally coiled, tip rounded, caudal alae present. Four pairs pre-cloacal and six pairs post-cloacal pedunculated papillae. Several longitudinal rows of pre-cloacal cuticular elevations. Spicules grossly unequal and dissimilar. Gubernaculum absent. Female tail with rounded tip. Amphidelphic. Vulva equatorial. Fully developed eggs thick shelled, with polar plugs and filaments at both poles, containing larvae when deposited.

Caballeronema wardlei, the type species, is known from two fish species in the Canadian Pacific.

***Caballeronema wardlei* (Smedley, 1934) Margolis, 1977**

Synonym: *Metabronema wardlei* Smedley, 1934

Description (after Margolis 1977). With characteristics of the genus.

Males: 26.3–36.9 long, 0.19–0.21 maximum width. Nerve ring 0.264–0.281 and excretory pore 0.401–0.446 from anterior end. Buccal cavity 0.077–0.115 long. Muscular oesophagus 0.894–1.030, and glandular oesophagus 6.41–8.83 long; ratio of their lengths 1: 7.2 to 1:1:8.6. Testis straight originating anterior to oesophago-intestinal junction, 7.14–9.75 from anterior end. Tail 0.275–0.326 long with rounded tip. Left spicule slender, 2.29–2.69 long; right spicule 0.168–0.184 long; ratio 13.6–15.4:1. Pre-cloacal papillae arranged in couples, two pairs immediately pre-cloacal, and two pairs slightly anterior to level of proximal end of withdrawn right spicule. First five pairs post-cloacal papillae approximately evenly distributed over length of tail. Phasmids at tail tip (Fig. 57A).

Females: 46.3–74.2 long, 0.22–0.34 maximum width. Nerve ring 0.261–0.349 and excretory pore 0.374–0.588 from anterior end. Buccal cavity 0.092–0.117 long. Muscular oesophagus 0.870–1.166 and glandular oesophagus 7.33–11.61 long; ratio of their lengths 1:8.1 to 1:1:9.9 (Fig. 57B). Anterior ovary originates near oesophago-intestinal junction; posterior ovary originates near level of anus. Vulva 26.25–36.15 or 48.7%–56.7% of total body length from anterior end of body. Eggs with vermiform larvae when shed, 0.043–0.047 × 0.028–0.032: at one pole a large plug with two long and up to six shorter more delicate filaments; at opposite pole a small plug with up to four of the shorter filaments (Fig. 57C). Tail 0.196–0.285 long. Phasmids near tail tip (Fig. 57D).

Sites: intestinal lumen, pyloric caeca

Hosts: *Scorpaenichthys marmoratus* (1, 2); *Sebastes nebulosus* (3)

Distribution: Pacific

Records: 1. Smedley 1934; 2. Margolis 1977; 3. Holmes 1990

***Capillospirura* Skryabin, 1924**

Generic diagnosis (after Appy & Anderson 1982). Cystidicolidae. Filiform worms. Four cephalic papillae present. Mouth dorso-ventrally elongate. Pseudolabia narrow and with a ridge-like apex. Submedian labia present. Mouth opening with opposing plates projecting from antero-lateral wall of buccal cavity. Sublabium in each subdorsal and subventral quadrant of mouth opening. Buccal cavity long and slender, dilated posteriorly behind mouth opening. Ten pairs caudal papillae, four pre-cloacal and six post-cloacal. Left spicule longer than right. Vulva near midbody. Parasitic in alimentary tract of fishes, mostly sturgeons.

One species, *C. pseudoargumentosa*, is known from several fish species in Canada.

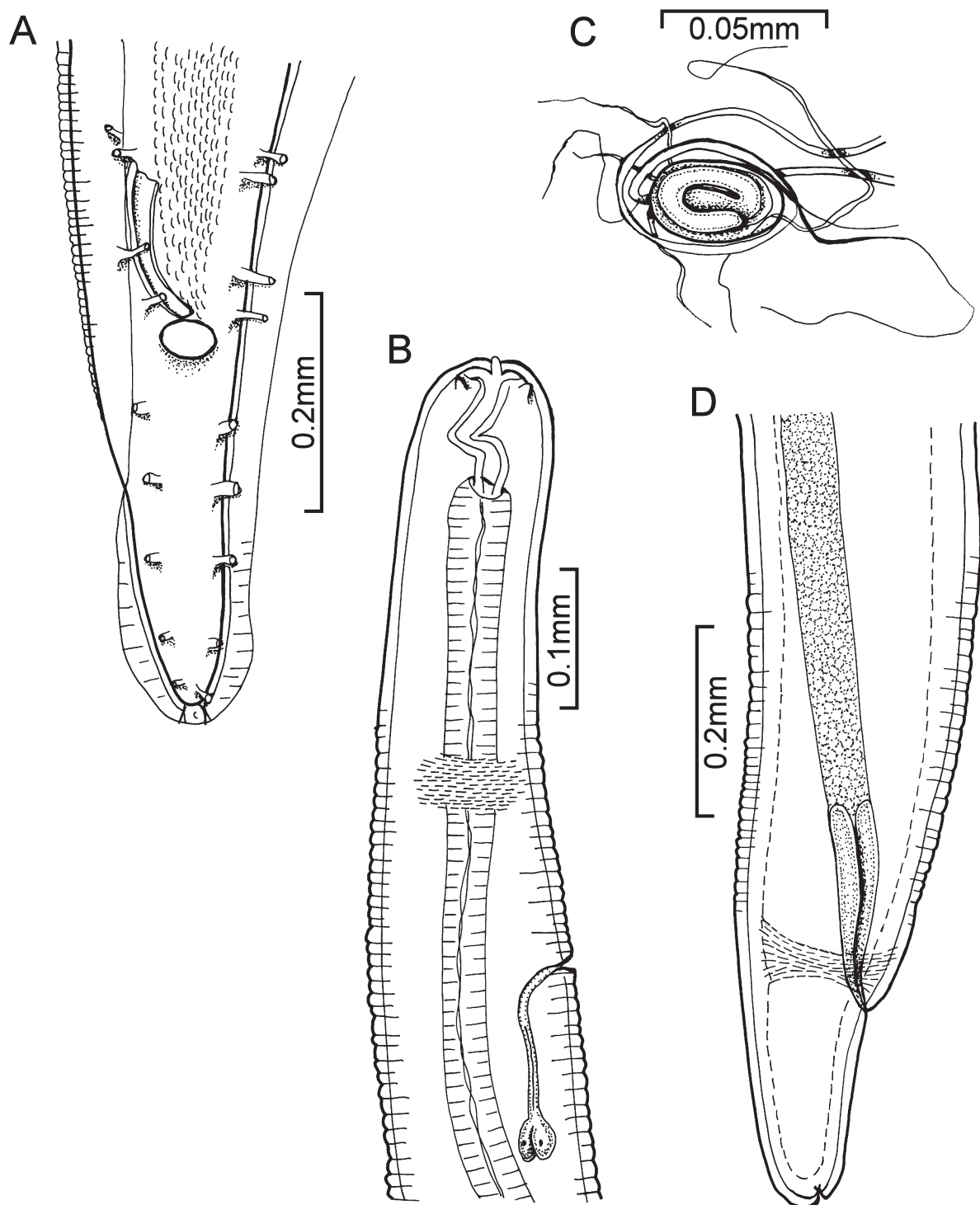


FIGURE 57. *Caballeronema wardlei* (Smedley, 1934) Margolis, 1977. A. male, posterior end, ventral view; B. female, anterior end, lateral view; C. egg [long filaments truncated]; D. female, posterior end, lateral view. (Redrawn from Margolis 1977)

***Capillospirura pseudoargumentosa* (Appy & Dadswell, 1978) Appy & Anderson, 1982**

Synonym: *Caballeronema pseudoargumentosus* Appy & Dadswell, 1978

Description (after Appy & Dadswell 1978). With characteristics of the genus.

Males: 7.7–10.0 long, 0.073–0.087 wide. Buccal cavity 0.065–0.090 long. Muscular oesophagus 0.277–0.439,

glandular oesophagus 1.466–1.931 (Fig. 58A), and tail 0.087–0.127 long. Nerve ring 0.135–0.225, excretory pore 0.259–0.394 and testis 2.463–4.018, respectively, from anterior end. Right spicule 0.110–0.138 and left spicule 0.492–0.598 long; ratio of right spicule to left spicule length 1:4.5. Right spicule has notch in distal tip; left spicule has ridge beginning near proximal end and extending posteriorly to near distal tip. Four pre-cloacal and six post-cloacal papillae. *Area rugosa* comprises about seven longitudinal rows of cuticular elevations (Fig. 58B). Caudal alae present.

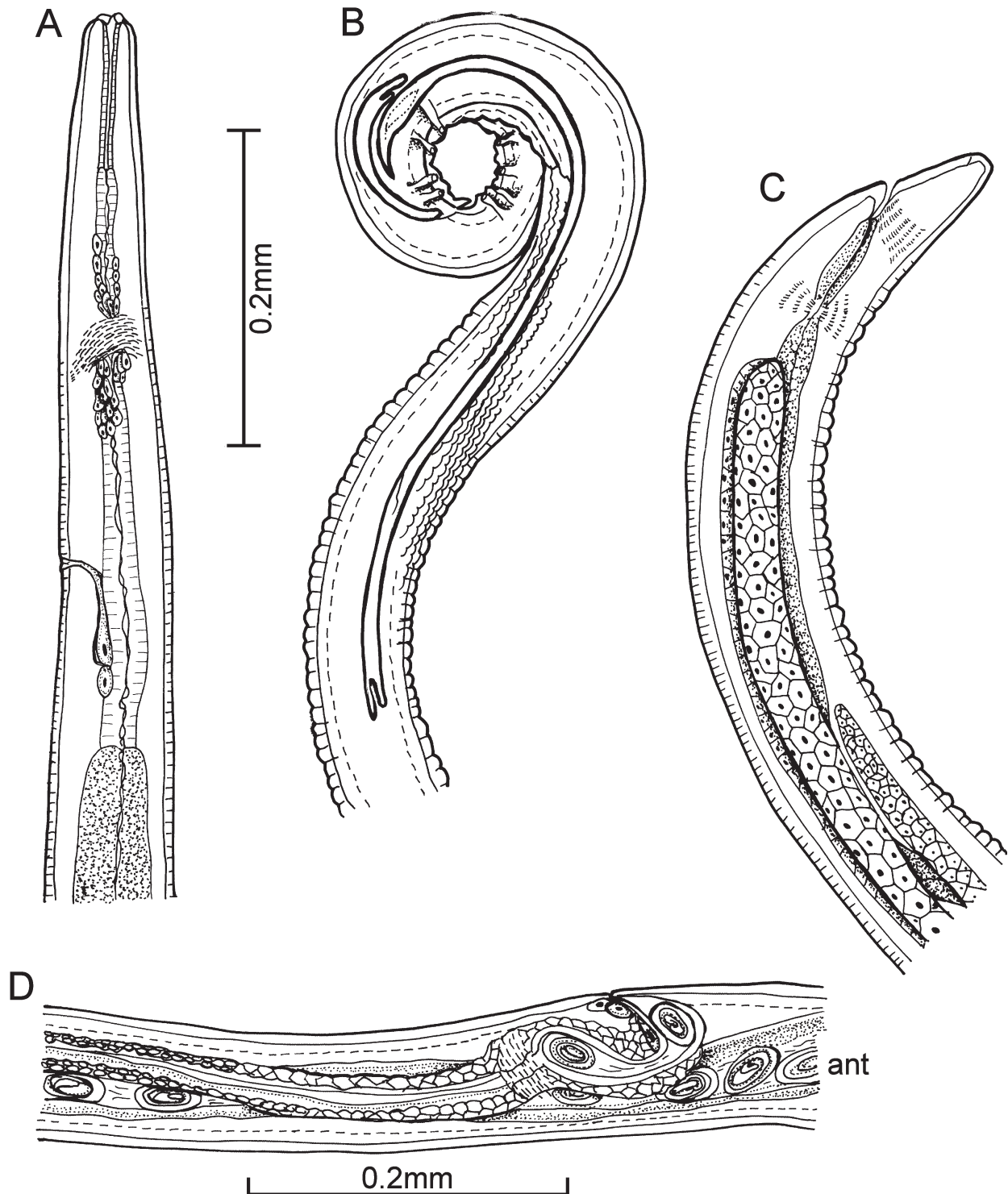


FIGURE 58. *Capillospirura pseudoargumentosa* (Appy & Dadswell, 1978) Appy & Anderson, 1982. A. male, anterior end; B. male, posterior end; C. female, posterior end; D. female, vulva, vagina and uterus [NB: for presentational reasons, polar filaments have been omitted from *in utero* eggs to avoid clutter]. (Redrawn from Appy & Dadswell 1978).

Females: 12.0–18.5 long, 0.089–0.109 wide. Buccal cavity 0.072–0.092 long. Muscular oesophagus 0.292–0.486, glandular oesophagus 1.456–1.962 long and tail 0.052–0.077 (Fig. 58C) long. Nerve ring 0.149–0.224, excretory pore 0.276–0.426, anterior ovary 1.528–2.025 and vulva 5.599–8.493 (Fig. 58D), respectively, from anterior end. Eggs 0.038–0.044 x 0.019–0.022. One polar plug with four to 10 filaments.

Site: alimentary tract

Hosts: *Acipenser brevirostrum* (1, 2, 3, 4); *Acipenser fulvescens* (5); *Acipenser oxyrinchus* (3); *Oncorhynchus mykiss* (4)

Distribution: Atlantic

Records: 1. Appy & Dadswell 1978 ; 2. Appy & Dadswell 1980 ; 3. Appy & Anderson 1982 ; 4. Appy & Dadswell 1983 (EX, AT)

***Cystidicola* Fischer, 1798**

Synonyms: *Fissula* Lamarck, 1801; *Ophiostoma* Rudolphi, 1801; *Ancyracanthus* Schneider, 1866; *Pseudancyracanthus* Skryabin, 1925; *Comephoronema* Layman, 1933

Preamble: Two species of *Cystidicola* are currently recognised: *C. farionis* and *C. stigmatura*. The species differ in adult and egg morphology, longevity, reproductive strategy, and host and geographical range (Miscampbell *et al.* 2004). *C. farionis* is short lived (about one year) and occurs in Salmonidae and Osmeridae in North America and Eurasia, whilst *C. stigmatura* is long lived (over 10 years) and occurs exclusively in *Salvelinus* spp. in North America. Suggestions over the years that Canadian fishes may harbour “strains” of *C. farionis* or that there is a third *Cystidicola* species (see Miscampbell *et al.* 2004, and references therein) are best addressed by further morphological and molecular studies.

Generic diagnosis (after Ko & Anderson 1969). Cystidicolidae. Pseudolabia small. Mouth opening dumb-bell shaped; armed with two rows of teeth, an exterior row comprising one large ventral, one large dorsal, two prominent lateral, and numerous small teeth in the form of fine serrations, and an internal row of 16 large teeth, four in each quadrant formed by the ventral, dorsal, and lateral teeth (Fig. 59A). Buccal cavity long and slender. Oesophagus divided into short anterior muscular and long posterior glandular portions. Excretory pore posterior to nerve ring, near junction of muscular and glandular oesophagus (Fig. 59B). Vulva slightly posterior to mid-body length. Tail short. Fully developed eggs bear lateral and/or polar filaments or a pair of lateral “lobes” (“floats” or “mammillations” *in litt.*). Parasitic in swim bladder of fishes.

Key to species of *Cystidicola*

- 1 Males 14–19 and females 15–21 long; fully developed eggs bear lateral and/or polar filaments *C. farionis*
- Males 17–31 and females 19–37 long; fully developed eggs bear lateral “lobes” (“floats” or “mammillations” *in litt.*) *C. stigmatura*

***Cystidicola farionis* Fischer, 1798**

Synonyms: *Cystidicola stigmatura* (Leidy, 1886) Ward & Magath, 1917 (*partim*); *Cystidicola canadensis* Skinker, 1930

Description (after Ko & Anderson 1969, and Miscampbell *et al.* 2004). With characteristics of the genus.

Males: body 16 (14–19) long. Width at nerve ring 0.117 (0.103–0.134), at anus 0.102 (0.104–0.134). Buccal cavity 0.122 (0.113–0.133) long (Fig. 59B). Nerve ring 0.315 (0.278–0.319) and excretory pore 0.512 (0.474–0.577) from anterior end. Muscular oesophagus 0.463 (0.402–0.608) long [length of glandular oesophagus not given]. Cuticular bosses present on ventro-lateral surface of caudal alae. Spicules unequal: left one 0.690 (0.640–0.730), right one 0.133 (0.103–0.148) long (Fig. 59C). Seven to nine double pairs of pre-cloacal papillae present. Four pairs of post-cloacal papillae present, the 1st and 3rd single pairs, the 2nd and 4th double pairs. Phasmids 0.025 (0.016–0.035) from posterior end. Tail 0.196 (0.155–0.227) long (Fig. 59C).

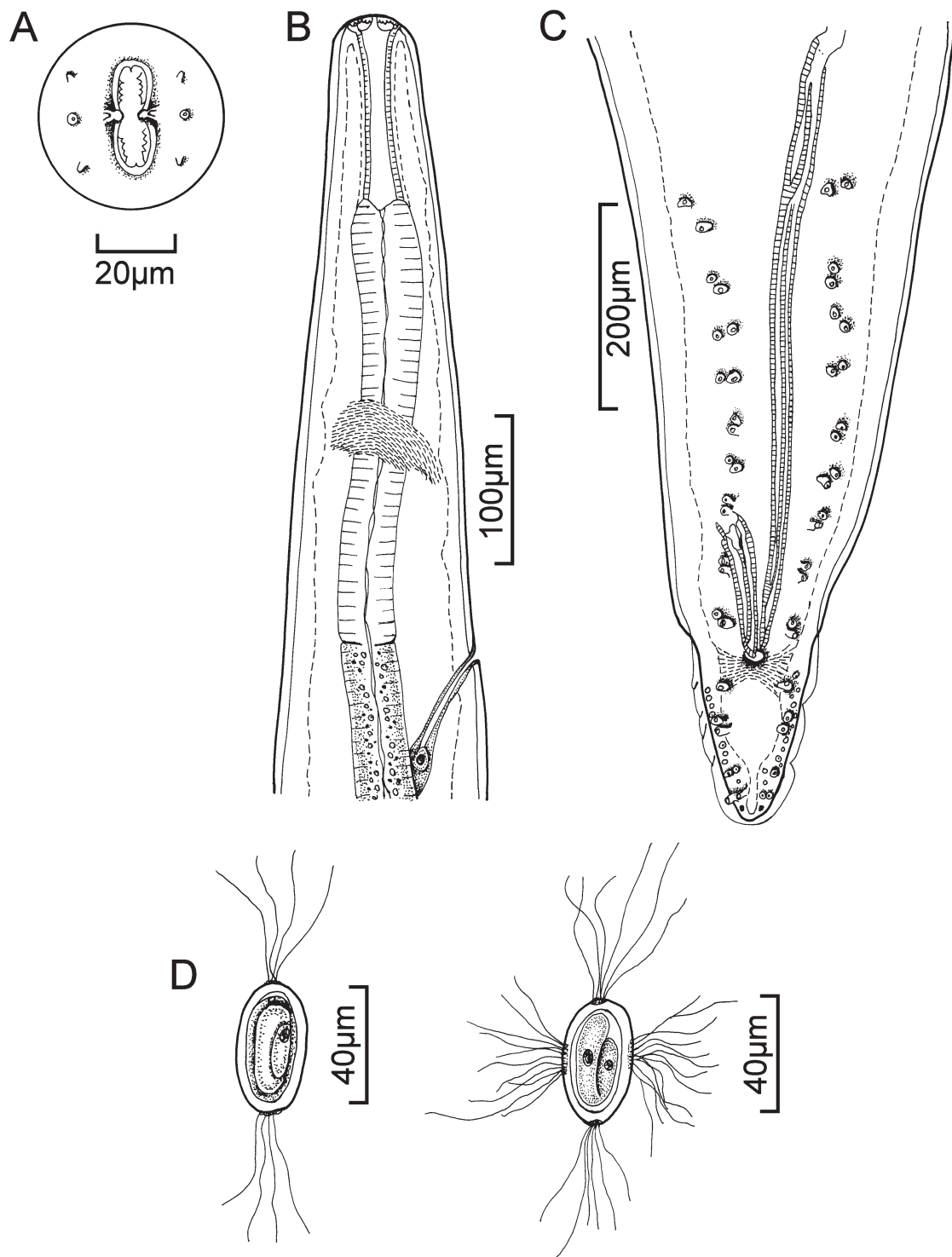


FIGURE 59. *Cystidicola farionis* Fischer, 1798. A. female, *en face* view; B. male, anterior end, lateral view; C. male, posterior end, ventral view; D. fully developed eggs with polar filaments only and with both lateral and polar filaments. (Redrawn from Ko & Anderson 1969).

Females: body 18 (15–21) long. Width at nerve ring 0.126 (0.124–0.134), at anus 0.100 (0.078–0.113). Buccal cavity 0.128 (0.113–0.134) long. Nerve ring 0.305 (0.278–0.330) and excretory pore 0.462 (0.412–0.515) from anterior end. Muscular oesophagus 0.443 (0.412–0.474) and glandular oesophagus 1.100 (0.958–1.185) long. Uterus amphidelphic, didelphic. Vulva slightly posterior to mid-body length, 11 (8–13) from anterior end. Phasmids 0.035 (0.034–0.037) from posterior end. Tail 0.130 (0.103–0.156) long. Fully developed eggs 0.042 (0.039–0.044) x 0.021 (0.021–0.023), bearing lateral and/or polar filaments (Fig. 59D).

Sites: body cavity, mesenteries, stomach, swim bladder

Hosts: *Apeltes quadracus* (9); *Catostomus catostomus* (10); *Coregonus artedi* (3, 4, 5, 17, 19, 30, 31, 35); *Coregonus clupeaformis* (4, 5, 10, 11, 15, 16, 17, 19, 20, 22, 23, 24, 25, 28, 29, 30, 31, 32, 35); *Coregonus hoyi* (3, 17, 31); *Coregonus nasus* (34); *Coregonus nigripinnis* (17); *Coregonus reighardi* (3); *Coregonus* sp. (8); *Esox americanus americanus* (2); *Oncorhynchus gorbuscha* (17, 31); *Oncorhynchus kisutch* (17, 19, 30, 31); *Oncorhynchus mykiss* (6, 12, 16, 17, 18, 22, 25, 30, 31); *Oncorhynchus nerka* (22, 25, 30); *Oncorhynchus tshawytscha* (17); *Osmerus mordax* (17, 29, 30, 31); *Perca flavescens* (11); *Prosopium coulterii* (12); *Prosopium cylindraceum* (5, 6, 10, 17, 30, 31); *Prosopium williamsoni* (6, 8, 12, 13, 21, 22, 25); Salmonidae gen. sp. (14); *Salmo trutta* (17); *Salvelinus alpinus* (22, 24, 26, 27); *Salvelinus fontinalis* (17, 33); *Salvelinus fontinalis* x *Salvelinus namaycush* (17, 30); *Salvelinus malma* (13, 18, 21, 22); *Salvelinus namaycush* (1, 8, 10, 12, 13, 17, 21, 22, 25, 35); *Sander vitreus* (11); *Thymallus arcticus* (10)

Distribution: Alberta, Atlantic, British Columbia, Manitoba, Northwest Territories, Newfoundland, Ontario, Quebec, Saskatchewan, Yukon Territory

Records: 1. Wright 1879 (ON); 2. Walton 1928 (ON); 3. Skinker 1930 (ON); 4. Ekbaum 1936 (MB, ON); 5. Bangham 1951 (ON); 6. Bangham & Adams 1954 (BC); 7. Dickson 1964 (MB); 8. Margolis 1967a (BC, ON); 9. Hanek & Threlfall 1970c (AT); 10. Arthur *et al.* 1976 (YT); 11. Watson 1977 (MB); 12. Mudry & Anderson 1977 (AB); 13. Anon. 1978 (BC); 14. J. D. Smith & Lankester 1979 (ON); 15. Watson & Dick 1979 (MB); 16. Black & Lankester 1980 (EX, ON); 17. Lankester & Smith 1980 (ON); 18. Anon. 1981 (BC); 19. Leong & Holmes 1981 (AB); 20. Samuel 1981 (AB); 21. Arai & Mudry 1983 (BC); 22. G. A. Black 1983c (NT); 23. McAllister & Mudry 1983 (AB); 24. Stewart & Bernier 1983 (NT); 25. Anon. 1984 (BC); 26. Stewart & Bernier 1984 (NT); 27. Black & Lankester 1984 (NT); 28. Dextrase & Lankester 1987 (ON); 29. Dechtiar & Christie 1988 (ON); 30. Dechtiar *et al.* 1988 (ON); 31. Dechtiar & Lawrie 1988 (ON); 32. Stock 1988 (AB); 33. Marcogliese & Cone 1991a (QC); 34. Choudhury & Dick 1997 (NT); 35. Baldwin & Goater 2003 (AB)

***Cystidicola lepisostei* Hunter & Bangham, 1933 sp. inq.**

On the basis of its cephalic structures Ko & Anderson (1969) considered this species to belong to *Cystidicola*. The specimens were recovered from the intestinal lumen rather than the swim bladder so it is likely they were from a salmonoid fish ingested by the host. Ko & Anderson (*op. cit.*) regarded it as a *species inquirendum*.

Site: intestinal lumen

Host: *Lepisosteus osseus*

Distribution: Ontario

Records: Hunter & Bangham 1933; Bangham & Hunter 1939

***Cystidicola serratus* (Wright, 1879) Railliet, 1916 sp. inq.**

From the cephalic structure and other morphological features Ko & Anderson (1969) concluded that this species should be regarded as *Rhabdochona species inquirendum*.

Site: heart

Host: *Coregonus artedi* or *Coregonus clupeaformis*

Distribution: Ontario

Record: Wright 1879

***Cystidicola stigmatura* (Leidy, 1886) Ward & Magath, 1917**

Synonym: *Cystidicola cristivomeri* White, 1941

Description (after White & Cable 1942, Ko & Anderson 1969, and Miscampbell *et al.* 2004). With characteristics of the genus.

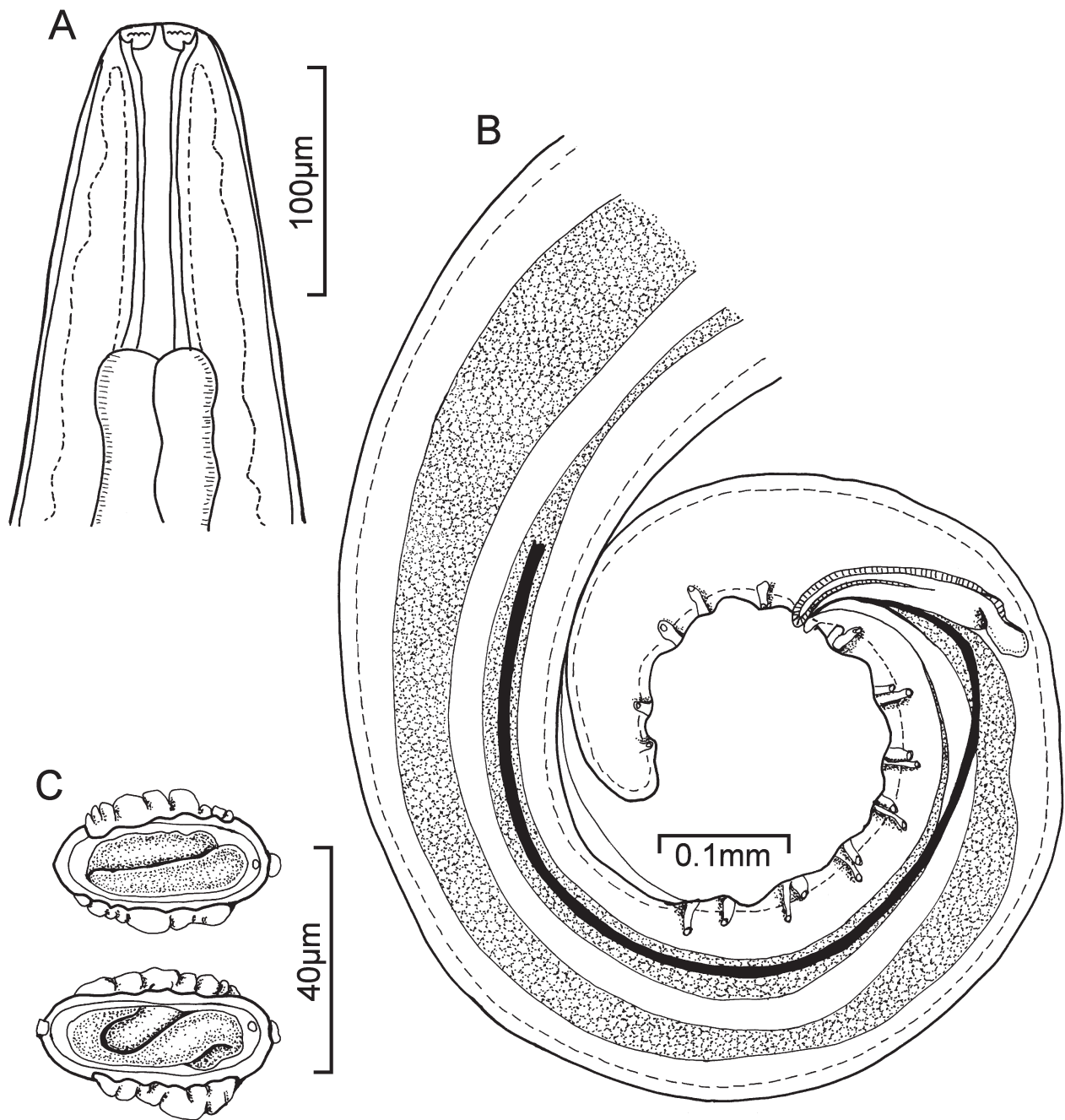


FIGURE 60. *Cystidicola stigmatura* (Leidy, 1886) Ward & Magath, 1917. A. male, anterior end, lateral view; B. male, posterior end, lateral view; C. fully developed eggs. (A. redrawn from Ko & Anderson 1969; B. redrawn from Skinner 1931; C. redrawn from White & Cable 1942)

Males: body 23 (17–31) long. Width at nerve ring 0.126 (0.101–0.144), at anus 0.125 (0.103–0.155). Buccal cavity 0.148 (0.124–0.174) long (Fig. 60A). Nerve ring 0.399 (0.371–0.443) from anterior end [position of excretory pore not given]. Muscular oesophagus 0.527 (0.433–0.597) and glandular oesophagus 3.110 (2.370–3.970) long. Cuticular bosses present on ventro-lateral surface of caudal alae. Spicules unequal: left one 0.900 (0.760–1.150), right one 0.200 (0.170–0.250) long. Seven to nine double pairs of pre-cloacal papillae present, the last pair sometimes single. Four pairs of post-cloacal papillae present, the 1st and 3rd single pairs, the 2nd and 4th double pairs. Phasmids 0.033 (0.025–0.037) from posterior end. Tail 0.244 (0.200–0.278) long (Fig. 60B).

Females: body 28 (19–37) long. Width at nerve ring 0.142 (0.124–0.155), at anus 0.131 (0.113–0.151). Buccal cavity 0.149 (0.134–0.165) long. Nerve ring 0.405 (0.371–0.433) and excretory pore 0.608 (0.525–0.690) from anterior end. Muscular oesophagus 0.524 (0.474–0.567) and glandular oesophagus 3.070 (2.630–3.310) long.

Uterus amphidelphic, didelphic. Vulva slightly posterior to middle of body, 16 (10–21) from anterior end. Phasmids 0.036 (0.034–0.037) from posterior end. Tail 0.212 (0.175–0.265) long. Fully developed eggs 0.045 (0.042–0.049) x 0.025 (0.023–0.026), bearing lateral “lobes” (“floats” or “mammillations” *in litt.*) (Fig. 60C).

Site: swim bladder

Hosts: *Coregonus artedii** (10, 14, 15, 19); *Coregonus clupeaformis** (1, 6, 9, 10, 12, 14, 15, 16, 19, 24, 41); *Coregonus hoyi** (10); *Myoxocephalus thompsonii* (29); *Oncorhynchus gorbuscha* (42); *Oncorhynchus kisutch* (17, 19); *Oncorhynchus nerka* (16); *Osmerus mordax* (16); *Prosopium cylindraceum* (10); *Salvelinus alpinus* (18, 20, 22, 23, 28, 30, 33, 34, 36, 37, 38, 39, 40); *Salvelinus fontinalis* (3, 5, 25); *Salvelinus fontinalis* x *Salvelinus namaycush* (16, 21); *Salvelinus namaycush* (2, 4, 5, 6, 7, 8, 9, 11, 12, 13, 14, 15, 25, 26, 27, 30, 31, 32, 33, 34, 35, 36, 37, 43)

Distribution: Alberta, British Columbia, Manitoba, Nunavut, NorthWest Territories, Ontario, Quebec, Saskatchewan, Yukon Territory

Records: 1. Smedley 1933 (AB, MB, SK); 2. White 1941 (ON); 3. Richardson 1942 (QC); 4. White and Cable 1942 (ON); 5. MacLulich 1943 (ON); 6. Miller 1945 (AB, NT); 7. Miller & Kennedy 1948 (NT); 8. Rawson 1951 (AB); 9. Stewart-Hay 1953a (MB); 10. Bangham 1955 (ON); 11. Rawson 1959 (SK); 12. Boyes & Anderson 1961 (ON); 13. Rawson 1961 (SK); 14. Ko & Anderson 1969 (ON); 15. Dechtiar 1972a (ON); 16. Collins & Dechtiar 1974 (ON); 17. Leong & Holmes 1974 (AB); 18. Jamieson & Freeman 1975 (NT); 19. Leong 1975 (AB); 20. Mudry & McCart 1978 (YT); 21. Dechtiar & Berst 1978 (ON); 22. Beverley-Burton 1978a (NT); 23. Eddy & Lankester 1978 (NT); 24. Pybus & Samuel 1978 (AB); 25. Lankester & Smith 1980 (ON); 26. Black & Lankester 1980 (EX, ON); 27. G. A. Black 1981b (EX, ON); 28. Black & Lankester 1981a (NT); 29. Black & Lankester 1981b (ON); 30. Black & Anderson 1982 (NU, ON); 31. Stewart & Bernier 1982 (NU); 32. G. A. Black 1983a (ON); 33. G. A. Black 1983b (NT, ON, QC, SK); 34. Stewart & Bernier 1983 (NT); 35. G. A. Black 1984a (ON); 36. G. A. Black 1984b (NT, NU, ON, SK); 37. Black & Lankester 1984 (NT, ON); 38. Curtis 1984 (NT, QC); 39. Stewart & Bernier 1984 (NT); 40. G. A. Black 1985 (NT); 41. Samuel 1985 (AB); 42. Anthony 1986 (ON); 43. Dechtiar & Lawrie 1988 (ON)

*Footnote: nematodes recovered from species of *Coregonus* were probably *Cystidicola farionis* misidentified as *C. stigmatura*. Most of the early records of *C. stigmatura* from other non-*Salvelinus* hosts pre-date the work of G. A. Black and coworkers and should be viewed with caution. Later records should be verified by examination of deposited specimens.

***Cystidicola* sp.**

Sites: body cavity, swim bladder

Hosts: *Coregonus artedii* (1, 9, 13); *Coregonus clupeaformis* (3, 5, 13); *Coregonus hoyi* (1); *Coregonus kiyi* (1); *Coregonus reighardi* (1); *Esox lucius* (10, 12); *Fundulus diaphanus* (6); *Oncorhynchus mykiss* (7); *Oncorhynchus tshawytscha* (4); *Prosopium coulterii* (8); *Prosopium williamsoni* (5, 13); *Salvelinus alpinus* (11); *Salvelinus namaycush* (2, 8)

Distribution: Alberta, British Columbia, Manitoba, Nova Scotia, Northwest Territories, Ontario, Pacific

Records: 1. Pritchard 1931 (ON); 2. White 1940 (ON); 3. Stewart-Hay 1953b (MB); 4. Godfrey 1968 (PA); 5. Paetz & Nelson 1970 (AB); 6. Wiles 1975 (NS); 7. Hoskins *et al.* 1976 (BC); 8. Mudry & Anderson 1977 (AB); 9. Anthony 1978a (ON); 10. McAllister & Mudry 1983 (AB); 11. Dick 1984 (NT); 12. Samuel 1985 (AB); 13. Nelson & Paetz 1992 (AB)

****Metabronema* sp.**

Site: ?

Host: *Thymallus arcticus*

Distribution: British Columbia

Record: Bangham & Adams 1954

Comment: This record is included for the sake of completeness. According to Margolis & Arthur (1979) the record

“is probably referable to the genus *Cystidicoloides*” but McDonald & Margolis (1995) made no reference to it. The larva—or larvae—may in fact represent *Salmonema* Moravec, Santos & Brasil-Sato, 2008 (see below).

***Salmonema* Moravec, Santos & Brasil-Sato, 2008**

Generic diagnosis (after Moravec *et al.* 2008). Cystidicolidae. Medium sized nematodes. Pseudolabia broad, flat; surface of each pseudolabium with small protuberance (pseudolabial protrusion). Mouth opening broad, somewhat dorso-ventrally elongated, demarcated by four narrow, unlobed sclerotized plates (sublabia). Four submedian cephalic papillae present. Vestibule elongated, dilated anteriorly (dorso-ventrally) to form funnel-shaped prostom. Deirids simple, small. Male with an *area rugosa*. Caudal alae in male well developed, supported by pedunculate papillae; four pairs of pre-cloacal papillae present. Spicules unequal and dissimilar. Female tail short. Uterus amphidelphic. Vulva in posterior half of body. Eggs elliptical, nonfilamented [*sic*], containing fully formed larva. Parasites of fresh-water fishes. Type species *S. ephemeridarum* (von Linstow, 1872).

Comments: design of a key to distinguish *Salmonema ephemeridarum* from *S. prevosti* (synonym *Metabronema prevosti*) would be fraught. Apart from the fact that *S. prevosti* males were inadequately described, and that neither males nor females were well illustrated (see below), there is the structure of the eggs. The foregoing generic diagnosis of *Salmonema* states that eggs are “nonfilamented” whilst Choquette’s (1951) original description refers to eggs bearing “coarse filaments at either poles which are provided with knobs”.

***Salmonema ephemeridarum* (von Linstow, 1872) Moravec, Santos & Brasil-Sato, 2008**

Synonyms: *Sterliadochona ephemeridarum* (von Linstow, 1872) Petter, 1974; *Metabronema harwoodi* Chandler, 1931; *Metabronema canadense* Skinker, 1931; *Metabronema salvelini* (Fujita, 1920) Baylis, 1935; *Cystidicoloides harwoodi* (Chandler, 1931) Dollfus & Campana-Rouget, 1956; *Sterliadochona tenuissima* (Zeder, 1800) Spassky & Roitman, 1957; *Cystidicoloides tenuissima* (Zeder, 1800) Rasheed, 1965; *Cystidicoloides ephemeridarum* (von Linstow, 1872) Moravec, 1981

Description (after Moravec 2013). With characteristics of the genus. Whitish, medium-sized worms with transversely striated cuticle; posterior margins of cuticular rings somewhat elevated. Pseudolabia broad, flat; each pseudolabium with dorsal and ventral lobes and a small papilla-like protrusion. Mouth opening oval, dorso-ventrally flattened, with two subdorsal and two subventral elongate sclerotized plates. Mouth surrounded by two dorso-lateral and two ventro-lateral cephalic papillae, and a pair small lateral amphids. Vestibule well sclerotized, long, in lateral view forming small funnel-shaped prostom. Deirids simple, very small, at level of posterior half of vestibule. Oesophagus comprises muscular and glandular portions. Nerve ring encircling muscular oesophagus, excretory pore below nerve ring level. Males much smaller than females.

Males: 5.25–8.16 long, 0.087–0.163 maximum width. Vestibule 0.094–0.147, muscular oesophagus 0.600–1.183, and glandular oesophagus 1.38–2.62 long. Nerve ring 0.177–0.255 and excretory pore 0.246–0.300 from anterior end (Fig. 61A). Posterior end usually spirally coiled, with fairly wide caudal alae. Caudal papillae: four pairs subventral pedunculate pre-cloacal papillae, and five pairs subventral pedunculate post-cloacal papillae. One pair very small ventral sessile papillae at level of last subventral pair. *Area rugosa* anterior to cloaca (Fig. 61B). Spicules unequal and dissimilar: large (left) one 0.262–0.345 long, distal end with conical cuticular membrane (Fig. 61C); short (right) one boat-shaped 0.081–0.140 long, with ventral cuticular ala along its entire length (Fig. 61D). Tail conical, 0.108–0.156 long, with rounded end.

Females: gravid worms 12.74–14.86 long, 0.244–0.313 maximum width. Vestibule 0.136–0.165, muscular oesophagus 1.36–1.50, and glandular oesophagus 2.12–3.26 long. Nerve ring 0.210–0.240 and excretory pore 0.303–0.330 from anterior end. Tail very short, rounded, 0.045–0.060 long. Vulva in posterior half of body, 8.09–9.18 from anterior end. Uterus amphidelphic. Eggs oval, thick-walled, with smooth surface, 0.036–0.048 x 0.024–0.030. Mature eggs contain a formed larva.

Sites: alimentary tract, swim bladder

Hosts: *Anguilla rostrata* (18); *Coregonus artedii* (42); *Coregonus clupeaformis* (17, 35, 41, 42, 43); *Cottus asper* (10); *Esox masquinongy* (8, 9); *Hiodon tergisus* (28); *Oncorhynchus clarkii* (10); *Oncorhynchus kisutch* (10,

13, 42, 43); *Oncorhynchus mykiss* (7, 10, 11, 25, 30, 34, 35, 41, 43); *Oncorhynchus nerka* (10, 13, 43); *Prosopium cylindraceum* (10); *Prosopium williamsoni* (10); *Rhinichthys cataractae* (10); *Salmo salar* (14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 29, 47); *Salmo trutta* (14, 16, 43); *Salvelinus alpinus* (6, 17, 18, 32, 37, 45); *Salvelinus fontinalis* (1, 2, 3, 4, 5, 7, 11, 12, 14, 16, 17, 18, 19, 20, 26, 27, 31, 36, 38, 39, 40, 41, 44, 46, 48); *Salvelinus malma* (10, 25, 34); *Salvelinus namaycush* (17, 42); *Thymallus arcticus* (25, 34); unspecified “dace” (8); unspecified “salmonids” (33)

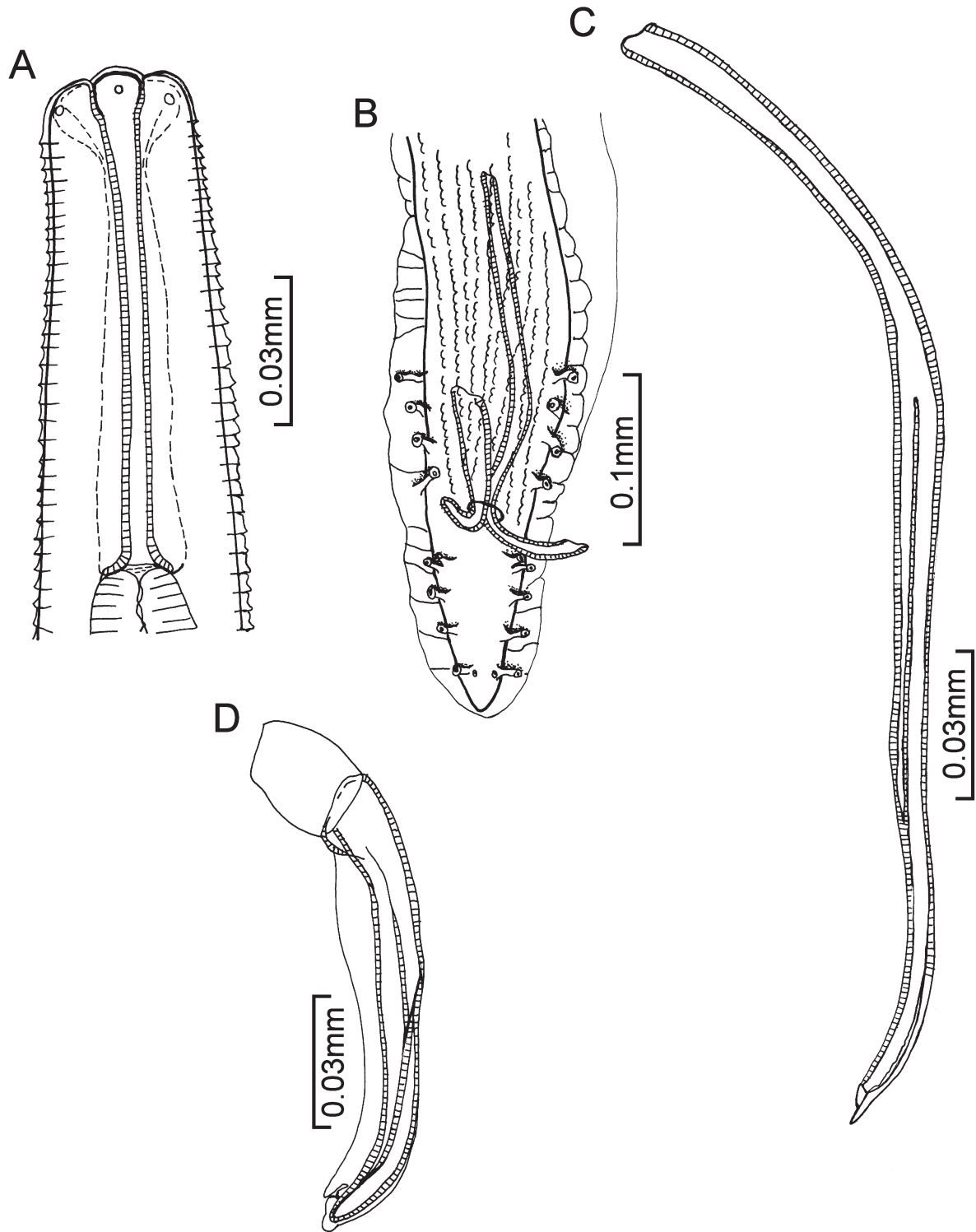


FIGURE 61. *Salmonema ephemeridarum* (von Linstow, 1872) Moravec, Santos & Brasil-Sato, 2008. A. anterior end, lateral view; B. male, posterior end, ventral view; C. left spicule; D. right spicule. (Redrawn from Moravec 2013).

Distribution: British Columbia, Central Canada, Labrador, Manitoba, New Brunswick, Newfoundland, Nova Scotia, Northwest Territories, Ontario, Prince Edward Island, Quebec

Records: 1. Skinker 1931 (QC); 2. Bangham & Hunter 1939 (ON); 3. Lyster 1940 (QC); 4. Richardson 1942 (QC); 5. Choquette 1948a (QC); 6. Choquette 1948b (QC); 7. Bangham 1951 (ON); 8. Choquette 1951b (QC); 9. Choquette 1951c (QC); 10. Bangham & Adams 1954 (BC); 11. Bangham 1955 (ON); 12. Choquette 1955 (QC); 13. Margolis 1965 (BC); 14. Pippy 1965 (NF); 15. Pippy 1967 (LB, NB, NL, PE); 16. Sandeman & Pippy 1967 (NF); 17. Hicks & Threlfall 1973 (LB); 18. Hanek & Molnar 1974 (QC); 19. Hare & Frantsi 1974 (NS); 20. Frantsi *et al.* 1975 (NB); 21. Hare 1975 (NB); 22. Hare & Burt 1975a (NB); 23. Hare & Burt 1975b (NB); 24. Hare & Burt 1976 (NB); 25. Anon. 1978 (BC); 26. Chinniah & Threlfall 1978 (LB); 27. Thompson & Threlfall 1978 (QC); 28. Glenn 1980 (MB); 29. Pippy 1980 (AT); 30. Anon. 1981 (BC); 31. G. A. Black 1981a (QC); 32. Dick & Belosevic 1981 (NT); 33. Margolis & Moravec 1982 (BC); 34. Arai & Mudry 1983 (BC); 35. Anon. 1984 (BC); 36. Cone & Ryan 1984 (NF); 37. Dick 1987 (NT); 38. Frimeth 1987a (NB); 39. Frimeth 1987b (NB); 40. Greenwood & Baker 1987 (ON); 41. Dechtiar & Christie 1988 (ON); 42. Dechtiar & Lawrie 1988 (ON); 43. Dechtiar *et al.* 1988 (ON); 44. Baggs & McT. Cowan 1989 (NF); 45. Bouillon & Dempson 1989 (QC); 46. Marcogliese & Cone 1991a (NB, NS, QC, LB, NL); 47. Marcogliese & Cone 1991b (NF); 48. Dubois *et al.* 1996 (QC)

***Salmonema prevosti* (Choquette, 1951) Moravec, Santos & Brasil-Sato, 2008**

Synonym: *Metabronema prevosti* Choquette, 1951

Description (after Choquette 1951b). With characteristics of the genus. Slender worms, the greatest width near posterior end, cuticle with transverse striations. Mouth opening dorso-ventrally elongated, surrounded by two slightly trilobed pseudolabia, leading to vestibule. Four large cephalic papillae at base of pseudolabia (Fig. 62A). Oesophagus comprises a muscular and a longer glandular portion.

Males (two specimens in “rather poor condition” were available—most measurements are for the type specimen only): 7.0 and 10.0 long. Vestibule 0.12, muscular oesophagus 0.38, and glandular oesophagus 2.91 long. Nerve ring 0.19 and excretory pore 0.30 from anterior end. Posterior end coiled with well developed caudal alae supported by four pairs pre-cloacal and five pairs post-cloacal papillae (Fig. 62B). Spicules unequal: left ones 0.8 and 1.2, and right ones 0.08 and 0.12. Gubernaculum not seen.

Females (14 specimens were available): 9.4 to 13.2 long. Vestibule 0.10 to 0.16, muscular oesophagus 0.22 to 0.39, and glandular oesophagus 1.67 to 2.35 long. Nerve ring 0.14 to 0.20, and excretory pore 0.22 to 0.25 from anterior end. Vulva situated slightly posterior to mid body. Eggs embryonated, 0.048 to 0.051 x 0.025, bear “coarse filaments at either poles which are provided with knobs”.

Site: intestinal lumen

Host: *Ameiurus nebulosus*

Distribution: Quebec

Record: Choquette 1951b

***Salmonema* sp.**

Site: alimentary tract

Host: *Acipenser fulvescens*

Distribution: Central Canada, Hudson Bay Drainage, Manitoba

Records: Choudhury & Dick 1993 (CC); Choudhury & Dick 1998 (HBD, MB)

***Salvelinema* Trofimenko, 1962**

Synonym: *Pseudometabronema* Bogdanova, 1963

Generic diagnosis (after Margolis & Kabata 1967, and Hoffman 1999). Cystidicolidae. Body slender, whitish, transparent when living, tapering at both ends. Mouth consists of dorsal and ventral semicircular or oval openings joined by narrow laterally compressed isthmus bounded by two well developed pseudolabia (Fig. 64A). Four inconspicuous submedian cephalic papillae present. Buccal cavity divided into an anterior expanded buccal capsule and a posterior slender pharynx which leads to a muscular oesophagus. Males with well developed tail, subventral cuticular alae and special ornamentation. Paired pedunculated pre-cloacal papillae variable in number. Five pairs of post-cloacal papillae present. Left spicule much longer than right one. Gubernaculum absent. Vulva anterior to mid-body region. Eggs thick-shelled with one or two polar plugs bearing filaments, and containing vermiform larvae when fully developed. Young eggs lack both polar plugs and filaments. Parasites of the swim bladder of salmonid fishes.

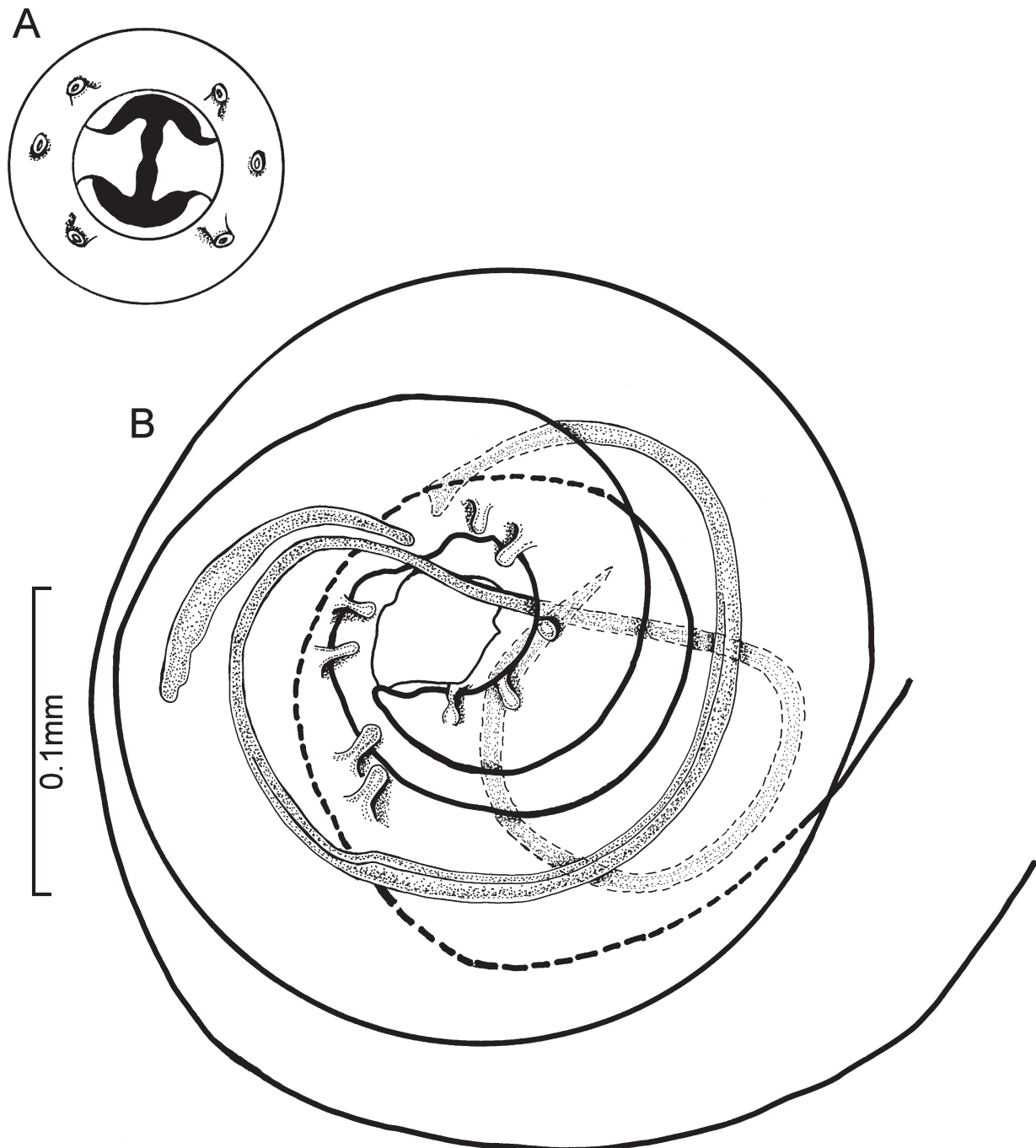


FIGURE 62. *Salmonema prevosti* (Choquette, 1951) Moravec, Santos & Brasil-Sato, 2008. A. *en face* view; B. male, posterior end, lateral view. NB: a scale bar was not provided in the original for A. (Redrawn from Choquette 1951)

Key to species of *Salvelinema*

- 1 Vagina directed anteriorly from vulva; both poles of mature egg with small polar plug and two thread-like filaments, exceptionally three threads on one pole *S. salmonicola*
- Vagina directed posteriorly from vulva; only one pole of mature egg with small polar plug and two thread-like filaments *S. walkeri*

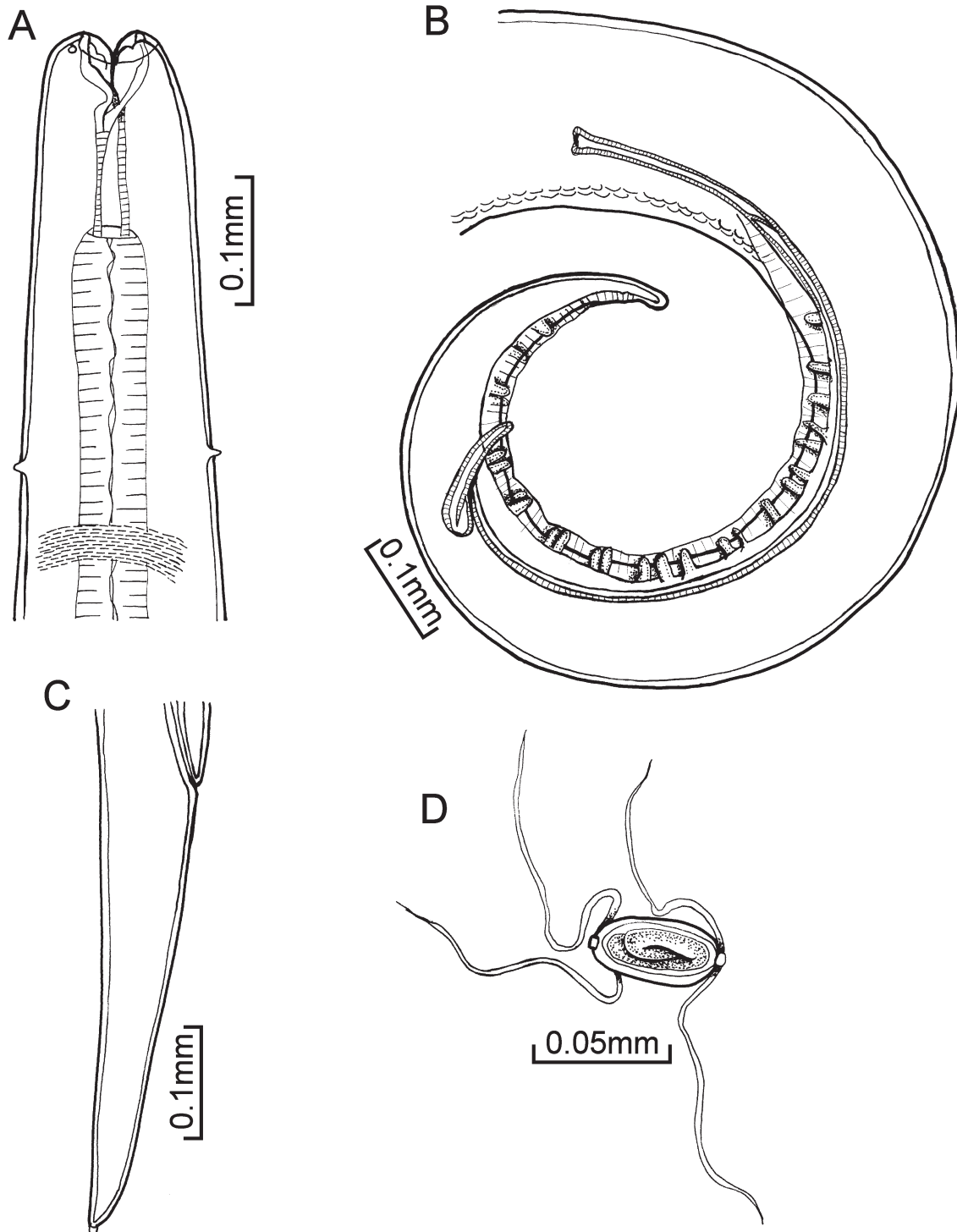


FIGURE 63. *Salvelinema salmonicola* (Ishii, 1916) Margolis, 1966. A. female, anterior end, dorso-ventral view; B. male, posterior end, lateral view; C. gravid female, tail, lateral view; D. mature egg. (Redrawn from Moravec & Nagasawa 1999b)

***Salvelinema salmonicola* (Ishii, 1916) Margolis, 1966**

Synonym: *Cystidicola salmonicola* Ishii, 1916

Description (after Moravec & Nagasawa 1999b). With characteristics of the genus.

Males (from *Oncorhynchus mykiss*): 15.66–18.99 long, 0.288–0.474 maximum width. Vestibule including prostom 0.116–0.144, muscular oesophagus 0.444–0.487, and glandular oesophagus 1.440–1.820 long. Deirids, nerve ring and excretory pore 0.278–0.320, 0.365–0.426 and 0.609–0.705, respectively, from anterior end. Caudal alae and ventral pre-cloacal cuticular ridges well developed. Pre-cloacal papillae: 19 to 21 pairs of subventral papillae, mostly arranged in couples. Post-cloacal papillae: six pairs of single papillae (occasionally seven papillae on right side and six on left). Left spicule slender 0.960–1.050 long, proximal end broader, distal end sharply pointed. Right spicule short, boat-shaped, 0.128–0.160 long, proximal end blunt, distal end rounded. Tail 0.224–0.264 long (Fig. 63B).

Females (from *O. mykiss*): gravid worms 20.830–27.910 long, 0.577–0.824 maximum width. Vestibule including prostom 0.120–0.160 (Fig. 63A), muscular oesophagus 0.539–0.566, and glandular oesophagus 1.700–2.130 long. Deirids, nerve ring and excretory pore 0.344–0.348, 0.409–0.522 and 0.679–0.722, respectively, from anterior end. Tail slender, 0.409–0.487 long with distal tip separated by cuticular constriction to form knob-like appendage (Fig. 63C). Vulva near midbody, 48–54% of body length. Vagina directed anteriorly from vulva. Uterus amphidelphic, ovaries in anterior and posterior parts of body. Mature eggs oval, thick walled, larvated, 42–50 µm x 18–20 µm; each pole with small plug and two thread-like filaments about 140 µm long (Fig. 63D); exceptionally there may be three filaments at one pole.

Site: swim bladder

Hosts: *Oncorhynchus kisutch* (1); *Salvelinus malma* (2, 3)

Distribution: British Columbia

Records: 1. Margolis 1966; 2. Margolis 1967a; 3. Margolis & Kabata 1967

***Salvelinema walkeri* (Ekbaum, 1935) Margolis, 1967**

Synonym: *Cystidicola walkeri* Ekbaum, 1935

Description (after Moravec & Nagasawa 1999b). With characteristics of the genus.

Males (from *Oncorhynchus kisutch*): 16.89–20.19 long, 0.371–0.412 maximum width. Vestibule including prostom 0.180–0.208, muscular oesophagus 0.383–0.539, and glandular oesophagus 1.510–1.870 long. Deirids, nerve ring and excretory pore 0.310–0.362, 0.383–0.461 and 0.635–0.679, respectively, from anterior end (Fig. 64B). Caudal alae and ventral pre-cloacal ridges well developed. Precloacal papillae: 18 to 26 pairs of subventral papillae arranged in couples. Post-cloacal papillae: six pairs of single papillae. Left spicule slender, 1.140–1.170 long, proximal end broad, distal tip sharply pointed. Right spicule short, boat-shaped, 0.152–0.192 long, proximal end blunt, distal end rounded. Tail 0.310–0.362 long (Fig. 64C).

Females (from *O. kisutch*): gravid worms 18.150–29.030 long, 0.453–0.597 maximum width. Vestibule including prostom 0.136–0.220, muscular oesophagus 0.365–0.531, and glandular oesophagus 1.470–1.840 long. Deirids, nerve ring and excretory pore 0.246–0.400, 0.296–0.487, and 0.661–0.809, respectively, from anterior end. Tail conical, 0.357–0.409 long, with rounded tip (Fig. 64D). Vulva in anterior half of body, 30–40% of body length. Vagina directed posteriorly from vulva. Uterus amphidelphic. Mature eggs oval, thick-walled, larvated, 42–54 µm x 20–24 µm; one pole with small plug and two thread-like filaments each about 360 µm long (Fig. 64E).

Site: swim bladder

Hosts: *Oncorhynchus clarkii* (6); *Oncorhynchus keta* (4, 6); *Oncorhynchus kisutch* (1, 2, 3, 4, 5); *Oncorhynchus tshawytscha* (5)

Distribution: Pacific

Records: 1. Ekbaum 1935; 2. Margolis 1967a; 3. Margolis 1967b; 4. Margolis & Kabata 1967; 5. Godfrey 1968; 6. Margolis & Moravec 1982

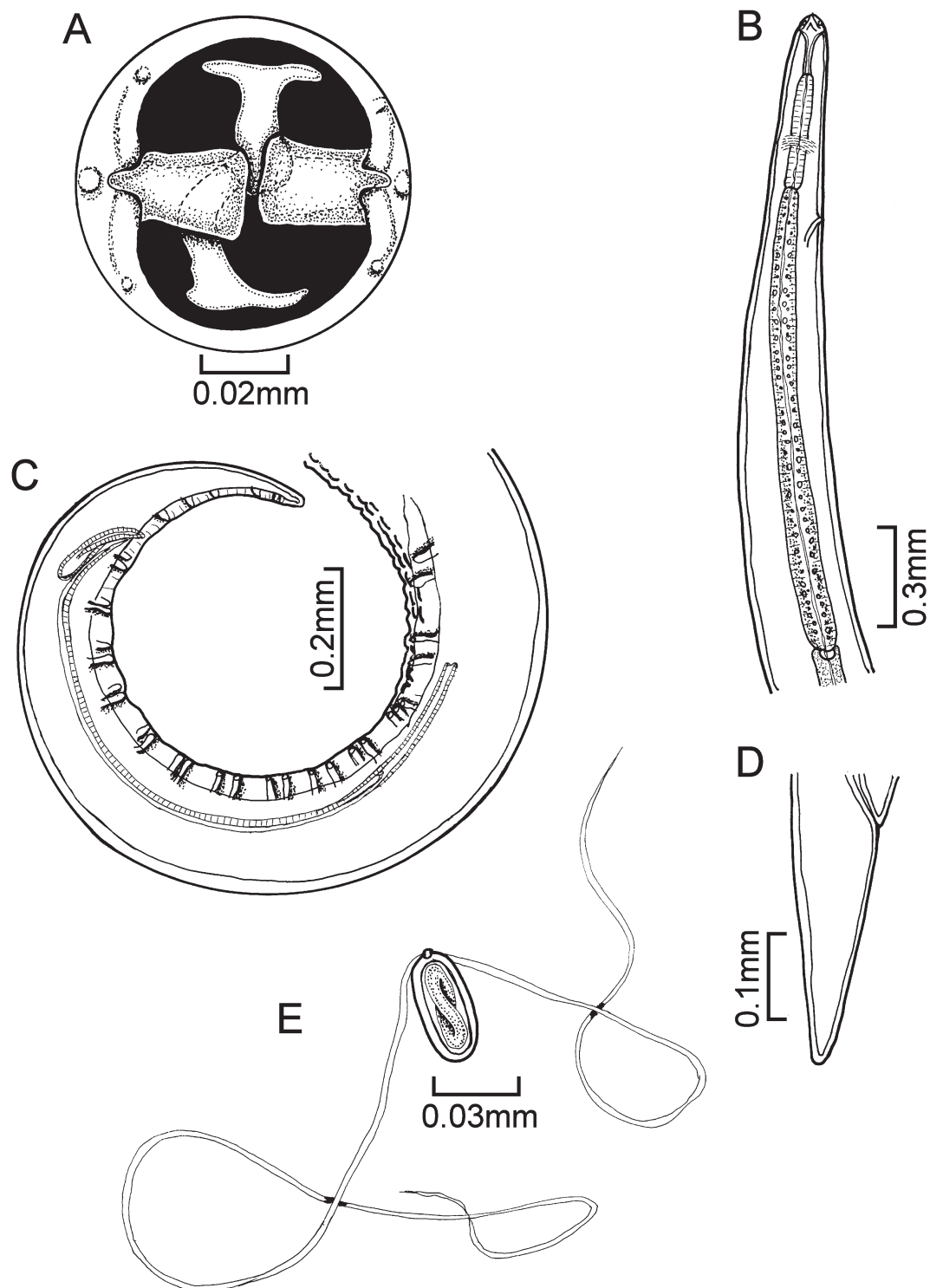


FIGURE 64. *Salvelinema walkeri* (Ekbaum, 1935) Margolis, 1967. A. *en face* view; B. male, anterior end, lateral view; C. male, posterior end, lateral view; D. gravid female, tail, lateral view; E. mature egg. (A. redrawn from Margolis & Kabata 1967; B. to E. redrawn from Moravec & Nagasawa 1999b)

Spinitectus Fourment, 1883

Generic diagnosis (after Moravec 2013). Cystidicolidae. Medium-sized worms with short unspined “head” region. Cuticle behind “head” with numerous transverse rings, each provided with row of posteriorly directed cuticular spines diminishing posteriorly. Pseudolabia broad, flat. Mouth opening elongated dorso-ventrally. Buccal cavity sclerotized, cylindrical, usually with dilated anterior part forming prostom. Oesophagus divided into muscular and

glandular portions. Males with caudal alae, supported by three to six pairs pre-cloacal pedunculate papillae, and an *area rugosa*. Gubernaculum absent. Vulva in posterior half of body. Uterus amphidelphic. Eggs elliptical, larvated, mature ones with or without filaments or polar caps. Parasites of alimentary tract of fresh-water and marine fishes, and amphibians. Type species *S. oviflagellis* Fourment, 1883.

Key to species of *Spinitectus*

Preamble: *Spinitectus cristatus* Railliet & Henry, 1915, from various species of hake *Urophycis* in the Atlantic, is recorded here for the sake of completeness. As discussed below, the description is inadequate, and the species cannot be included in the following key.

- | | | |
|---|---|-------------------------|
| 1 | Buccal cavity less than half length of “head”; vagina directed anteriorly; excretory pore between the 4 th and 5 th spine rows . | 2 |
| - | Buccal cavity at least as long as “head”; vagina directed posteriorly; excretory pore between the 6 th and 7 th or 8 th and 9 th spine rows | 3 |
| 2 | Circlets and semicirclets of spines reach near anus in females; ratio of oesophagus to body length 1:4 to 1:5; right spicule with heel-like barb. | <i>S. acipenseri</i> |
| - | Spines not reaching near anus in females; ratio of oesophagus to body length 1:2 to 1:3; right spicule lacks heel-like barb | <i>S. gracilis</i> |
| 3 | Excretory pore between the 8 th and 9 th spine rows; spines < 0.015 long | <i>S. carolini</i> |
| - | Excretory pore between the 6 th and 7 th spine rows; spines > 0.020 long. | <i>S. macrospinosus</i> |

Spinitectus acipenseri Choudhury & Dick, 1992

Includes: *Spinitectus gracilis acipenseri* of Choudhury, Dick, Holloway & Ottinger (1990); *Spinitectus acipenseri* of Choudhury & Dick (1991); *Spinitectus gracilis acipenseri* of Swanson, Kansas, Matkowski & Graveline (1991). Description (after Choudhury & Dick 1992). With characteristics of the genus. “Head” region without spines but rest of body possessing transverse rows of spines. Spine rows discontinuous over lateral lines, appearing as two semicirclets of spines in same plane. First spine row with 20 to 22 spines, numbers increasing posteriorly to as many as 30 (row 6). Spines < 0.015 long. Mouth slit-like, bordered by two sublabia with straight inner margins. Four barely visible cephalic papillae, two posterior to each lip base. Amphids not observed. Excretory gland short and narrow with basal nucleus lying beside muscular oesophagus; excretory pore opens between the 4th and 5th spine rows. Nerve ring immediately posterior to 2nd row of spines. Buccal cavity short (Fig. 65A).

Males (measurements of holotype, and range of paratypes in parentheses): Body 4.85 (3.65–6.1) long, 0.091 (0.805–0.124) wide. “Head” 0.104 (0.073–0.132), buccal capsule 0.032 (0.029–0.044), muscular oesophagus 0.243 (0.226–0.336) and glandular oesophagus 0.918 (0.700–1.066) long. Nerve ring 0.125 (0.102–0.161) from anterior end. Left spicule 0.315 (0.300–0.350) long; arcuate, scoop shaped distally, pointed tip. Right spicule 0.100 (0.096–0.103) long; helically bent like ram’s horn, prominent terminal barb, resembling an heel (Fig. 65C). Tail 0.127 (0.102–0.139) long. Maximum spine size 0.012 (0.012–0.013). Tail end often twisted into one or two turns. Four pairs pre-cloacal and six pairs post-cloacal pedunculated papillae present (Fig. 65B). *Area rugosa* comprises about eight longitudinal rows of cuticular elevations.

Females (measurements of allotype, and range of paratypes in parentheses): Body 7.25 (4.2–8.8) long, 0.136 (0.085–0.175) wide. “Head” 0.125 (0.073–0.139), buccal capsule 0.043 (0.029–0.044), muscular oesophagus 0.300 (0.227–0.416), and glandular oesophagus 0.909 (0.643–1.336) long. Nerve ring 0.143 (0.139–0.0.197) from anterior end. Two folded ovaries, one posterior near end of gut (Fig. 65D), the other in region of glandular oesophagus. Amphidelphic, vagina fairly long, directed anteriorly, opening into prominent vulva with bulbous lip (Fig. 65E). Tail 0.068 (0.066–0.110) long, bears terminal spine. Maximum spine size 0.012 (0.011–0.015). Vaginal eggs 0.037 (0.034–0.040) x 0.023 (0.023–0.025).

Site: alimentary tract

Host: *Acipenser fulvescens*

Distribution: Central Canada, Hudson Bay Drainage, Manitoba, Ontario, Saskatchewan

Records: Choudhury *et al.* 1990 (MB, ON, SK); Choudhury & Dick 1991 (MB, SK); Swanson *et al.* 1991 (MB); Choudhury & Dick 1992 (MB, SK); Choudhury & Dick 1993 (CC); Choudhury & Dick 2001 (HBD)

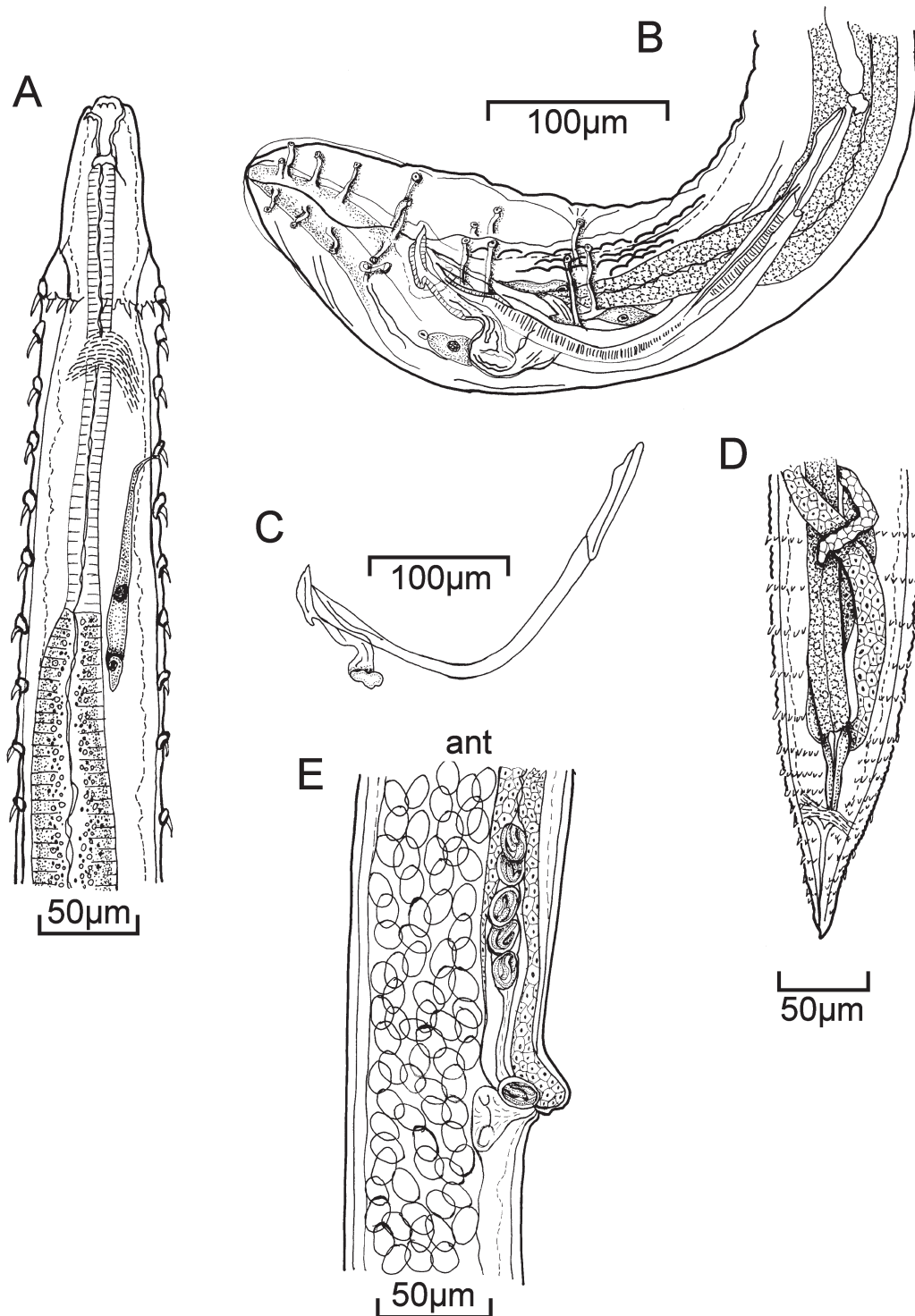


FIGURE 65. *Spinitectus acipenseri* Choudhury & Dick, 1992. A. female, anterior end, lateral view; B. male, posterior end; C. spicules; D. female, posterior end, ventral view; E. female, vaginal region. (Redrawn from Choudhury & Dick 1992)

***Spinitectus carolini* Holl, 1928**

Description (after Mueller & Van Cleave 1932, Jilek & Crites 1982a, and Christian 1972). With characteristics of the genus. “Head” region without spines. Four cephalic papillae present. Two amphids each with two pore-like

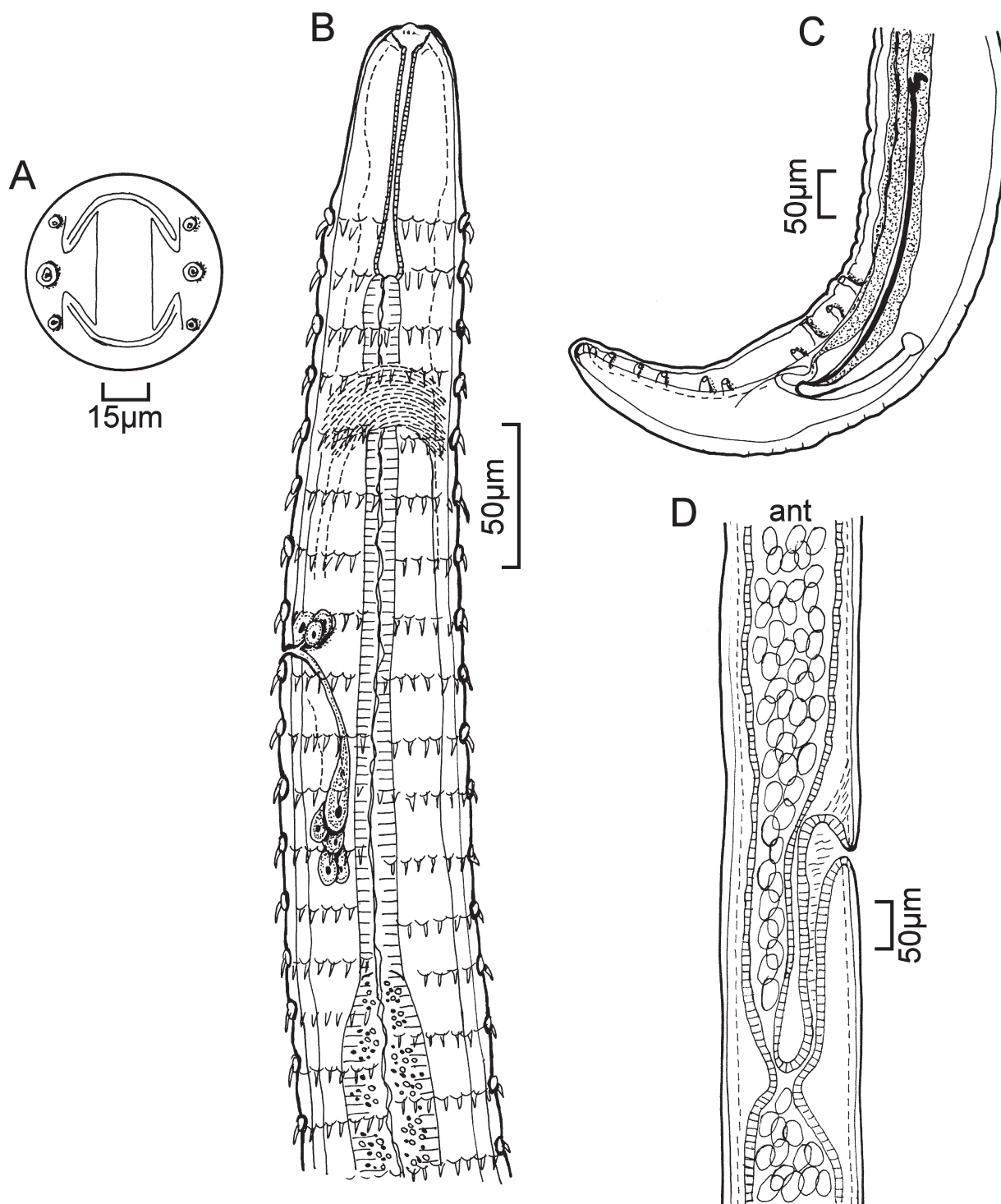


FIGURE 66. *Spinitectus carolini* Holl, 1928. A. adult, *en face* view; B. adult, anterior end, lateral view; C. adult male, posterior end, lateral view; D. adult female, mid-section, vaginal region. (A., C. and D. redrawn from Jilek & Crites 1982a; B. redrawn from Mueller & Van Cleave 1932)

openings situated laterally on pseudolabia (Fig. 66A). Deirids between 1st and 2nd spine rows. 15 to 20 sharp spines present per row; spines < 0.015 long. Anterior rows of spines arranged in 4 sectors. Spines absent over lateral lines, and decreasing in number and size posteriorly. Buccal cavity relatively long, straight and thin-walled. Muscular oesophagus begins at level of 2nd row of spines, and is about half the width of the glandular oesophagus (Fig. 66B).

Males: Body slender 3.31 (2.78–3.45) long, 0.098 (0.087–0.106) wide. Nerve ring 0.145 (0.133–0.151), and excretory pore 0.202 (0.187–0.221) from anterior end. Excretory pore between the 8th and 9th spine rows. Muscular

oesophagus 0.172–0.266 long [mean length not given]. Glandular oesophagus 1.403 (1.201–1.497) long. Narrow caudal alae. Four pairs pre-cloacal and five pairs post-cloacal pedunculate papillae present (Fig. 66C). Right spicule short, proximally expanded, distal tip with large ventral barb [length not reported]. Left spicule long, slender, evenly curved with tail, divided into shaft and flanged blade [length not reported]. *Area rugosa* present.

Females: Body slender 5.13 (4.35–5.70) long, 0.110 (0.105–0.114) wide. Nerve ring 0.152 (0.140–0.156) and excretory pore 0.212 (0.203–0.221) from anterior end. Muscular oesophagus 0.194 (0.168–0.235) long, and glandular oesophagus 1.590 (1.437–1.702) long. Vulva located just posterior to middle of body. Ovijector well developed. Vagina directed posteriorly (Fig. 66D). Amphidelphic. Eggs thick-shelled. Tail with heart-shaped mucron.

Site: intestinal lumen

Hosts: *Ambloplites rupestris* (1, 4, 6, 8); *Ameiurus nebulosus* (6); *Amia calva* (11); *Coregonus clupeaformis* (4); *Cyprinus carpio* (4); *Esox lucius* (10); *Lepomis gibbosus* (1, 2, 3, 4, 8, 9); *Lepomis macrochirus* (8, 9); *Micropterus dolomieu* (1, 2, 3, 4, 12); *Micropterus salmoides* (1, 4, 8); *Morone americana* (9); *Morone chrysops* (4, 5, 7, 11); *Osmerus mordax* (4); *Perca flavescens* (2, 10); *Pomoxis nigromaculatus* (8); *Sander vitreus* (4)

Distribution: Ontario

Records: 1. Bangham & Hunter 1939; 2. Bangham 1941; 3. Bangham & Venard 1946; 4. Bangham 1951; 5. Bangham 1955; 6. Dechtiar 1972a; 7. Anthony 1984; 8. Anthony 1985; 9. Dechtiar & Christie 1988; 10. Dechtiar & Lawrie 1988; 11. Dechtiar *et al.* 1988; 12. Dechtiar & Nepszy 1988

***Spinitectus cristatus* Railliet and Henry, 1915**

This species was originally described by Linton (1901) from *Phycis tenuis* (= *Urophycis tenuis*) from the Atlantic coast of America (Nantucket) as *Filaria serrata* Linton, 1892. Various workers including Berland (1961), Rahman (1964), Scott (1987), Køie (1993) and Moravec & Klimpel (2007) concluded that the description is inadequate.

According to Linton, *S. cristatus* males show the following features: length 5.8; maximum breadth 0.1; over 100 transverse rows of spines; spines 0.01 long; four precloacal and six post-cloacal papillae; tail ends blindly, rounded extremity; cloacal aperture 0.16 from tail tip. Apart from the inadequacy of the description, there is an inconsistency in the lengths recorded for the spicules (0.06 and 0.03) and the illustrations of them.

Site: intestinal lumen

Hosts: *Phycis chesteri*; *Urophycis chuss*; *Urophycis tenuis*

Distribution: Atlantic

Record: Scott 1987

*****Spinitectus gracilis* Ward & Magath, 1917**

Description (after Mueller & Van Cleave 1932, and Jilek & Crites 1982b). With characteristics of the genus. “Head” region without spines. Four cephalic papillae, and two amphids each with two pore-like openings situated on pseudolabia. Deirids between 1st and 2nd rows of spines. 35 to 45 short sharp spines present per row. Spines absent over lateral lines, and decreasing in number and size posteriorly. Spines < 0.015 long. Buccal cavity short, with sharp bend. Width of muscular oesophagus about half that of glandular oesophagus (Fig. 67A).

Males: body slender, 4.150 (3.852–4.390) long, 0.117 (0.102–0.130) wide. Nerve ring 0.150 (0.142–0.155) from anterior end. Excretory pore between the 4th and 5th spine rows (Fig. 67A). Muscular oesophagus 0.257 (0.203–0.303), and glandular oesophagus 1.805 (1.607–1.895) long. Alae narrow. Four pairs pre-cloacal and five pairs post-cloacal pedunculate papillae. Right spicule short and thick with 90° bend and thickened proximal portion, distal end pointed, lacks barb [length not reported]. Left spicule long, slender [length not reported]. Tail tip rounded (Fig. 67B). *Area rugosa* present.

Females: body slender 6.250 (5.648–7.390) long, 0.155 (0.147–0.163) wide. Nerve ring 0.160 (0.153–0.167) and excretory pore 0.228 (0.203–0.235) from anterior end. Muscular oesophagus 0.229 (0.184–0.243) and glandular oesophagus 1.903 (1.784–2.075) long. Vulva immediately posterior to middle of body. Ovijector well developed. Vagina directed anteriorly (Fig. 67C). Amphidelphic. Eggs thick-shelled. Tail with spine (Fig. 67D).

Comment: Choudhury & Dick (1992) discussed discrepancies in the four published descriptions of *S. gracilis* so the foregoing description should be interpreted with caution.

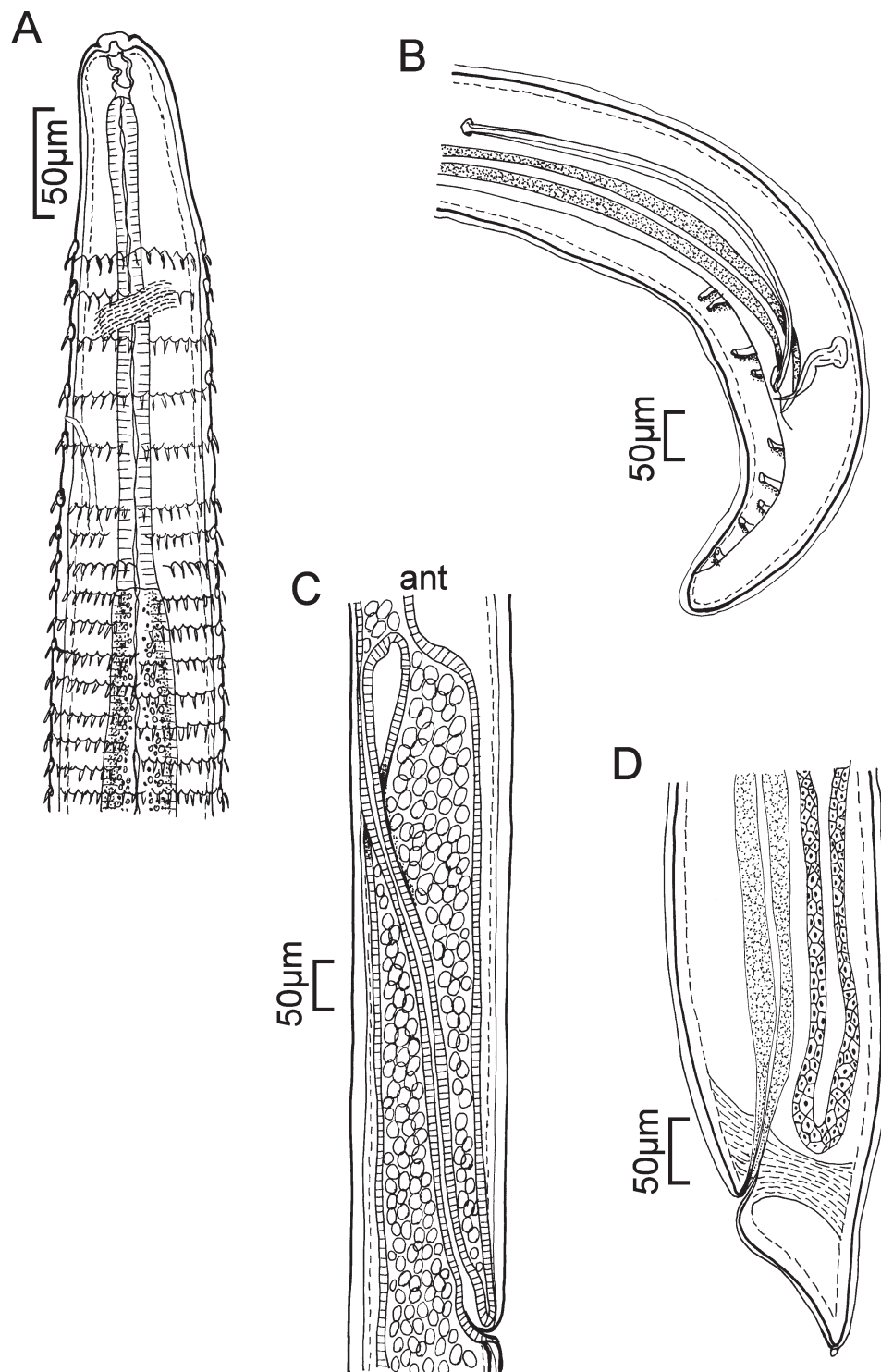


FIGURE 67. *Spinitectus gracilis* Ward & Magath, 1917. A. adult, anterior end, lateral view; B. adult male, posterior end, lateral view; C. adult female, mid-section, vaginal region; D. adult female, posterior end, lateral view. (A. redrawn from Mueller & Van Cleave 1932; B., C. and D. redrawn from Jilek & Crites 1982b)

Site: intestinal lumen

Hosts: *Acipenser fulvescens* (16, 19, 22); *Ambloplites rupestris* (16, 19, 27); *Ameiurus nebulosus* (2, 4); *Aplodinotus grunniens* (1); *Catostomus commersonii* (14); *Coregonus artedii* (7, 10, 12, 14, 20, 24); *Coregonus clupeaformis* (2, 3, 4, 5, 9, 10, 12, 14); *Cottus cognatus* (21); *Cyprinus carpio* (4, 5, 19); *Esox americanus*

vermiculatus (1, 6); *Esox lucius* (1, 10, 13, 14, 20, 24); *Ictalurus punctatus* (1); *Lepomis gibbosus* (2, 3); *Lota lota* (4, 5, 7, 19); *Luxilus cornutus* (20, 24); *Micropterus dolomieu* (4, 5, 27); *Moxostoma anisurum* (7); *Notropis hudsonius* (4, 5); *Noturus flavus* (1); *Oncorhynchus nerka* (9, 19); *Osmerus mordax* (4, 5, 16); *Perca flavescens* (3, 4, 5, 7, 8, 9, 14, 15, 16, 20, 23, 24, 25, 26); *Percina caprodes* (24); *Percopsis omiscomaycus* (5, 7, 9, 16, 17, 20, 24); *Pomoxis nigromaculatus* (4, 5, 7, 19); *Prosopium cylindraceum* (3, 17); *Salvelinus fontinalis* x *Salvelinus namaycush* (9, 11, 19); *Sander vitreus* (14, 18)

Distribution: Manitoba, Ontario, Saskatchewan

Records: 1. Bangham & Hunter 1939 (ON); 2. Bangham 1941 (ON); 3. Bangham & Venard 1946 (ON); 4. Bangham 1951 (ON); 5. Bangham 1955 (ON); 6. Crossman 1962 (ON); 7. Dechtiar 1972a (ON); 8. Cannon 1973 (ON); 9. Collins & Dechtiar 1974 (ON); 10. Watson 1977 (MB); 11. Dechtiar & Berst 1978 (ON); 12. Watson & Dick 1979 (MB); 13. Watson & Dick 1980 (MB); 14. Poole 1983 (MB); 15. Poole & Dick 1985 (MB); 16. Dechtiar & Christie 1988 (ON); 17. Dechtiar & Lawrie (ON); 18. Dechtiar & Nepszy 1988 (ON); 19. Dechtiar *et al.* 1988 (ON); 20. Szalai 1989 (MB); 21. Dechtiar *et al.* 1989 (ON); 22. Choudhury *et al.* 1990 ((MB, SK); 23. Szalai & Dick 1991 (MB); 24. Szalai *et al.* 1992a (MB); 25. Carney & Dick 1999 (MB); 26. Carney & Dick 2000 (MB); 27. Choudhury & Perryman 2003 (MB)

***Spinitectus macrospinosus* Choudhury & Perryman, 2003**

Description (after Choudhury & Perryman 2003). With characteristics of the genus. “Head” region without spines, gradually widening posteriorly; transverse rows of cuticular spines prominent in the oesophageal region. Rows of spines divided into four sectors; prominent in the anterior third of body; sectors approximately on same level in anterior region of body; arrangement in sectors less well defined posterior to oesophageal region. First row with small spines; spines increasing in size posteriorly in oesophageal region before becoming narrower, then smaller; sectors of spine-rows becoming widely separated posteriorly in oesophageal region. Spines decreasing in number over first four rows (Fig. 68A). In oesophageal region mean length of spines is 0.0218 in males, and 0.0268 in females. Mouth terminal, ovoid, elongated along dorso-ventral axis, bordered by four low, submedian labia (two subdorsal, two subventral) bearing narrow, thickened sublabia, by two lateral pseudolabia, each sublabium bearing single papilla-like protuberance; inner margin of pseudolabia narrower; base widening inside oral cavity and continuous with inner wall of prostom. Short prostom followed by narrow cuticularized relatively long buccal cavity that extends beyond level of 1st row of spines; oesophagus with anterior muscular region, longer posterior glandular portion; intestine ending in short rectum surrounded by a few large gland cells; rectum leading to ventral slit-like anus. Anterior end with paired lateral amphids, and two pairs of lateral papillae. Small, simple lateral deirids between first two spine rows. Excretory pore between the 6th and 7th spine rows (Fig. 68A).

Males: 5.5–8.0 long, 0.070–0.085 maximum width. Spination begins 0.075–0.090 from anterior end; 56 to 67 rows of spines discerned in oesophageal region; spines extend to posterior 3rd of body, not discernible beyond region of seminal vesicle. Nerve ring 0.150–0.165 from anterior end. Prostom plus buccal cavity 0.120–0.132, muscular oesophagus 0.335–0.445, and glandular oesophagus 1.800–2.480 long. Testes originate in posterior 3rd of body; they extend anteriorly, loop posterior to oesophageal-intestinal junction before continuing posteriorly to form seminal vesicle occupying most of pseudocoelom width in posterior quarter of body, merging posteriorly with *vas deferens*. Posterior region of body often coiled, with an *area rugosa* in pre-cloacal region. Caudal region with alae flanking most of tail; four pairs of pre-cloacal papillae; six pairs of post-cloacal papillae, 6th pair (possibly phasmids) medial to 5th pair. Spicules unequal, left one 0.125–0.155 long, appearing ensheathed, with sclerotized and unsclerotized parts, bent near middle, blade portion narrowing to rounded end. Right spicule arcuate, 0.055–0.070 long, with narrow sclerotized portion and broad unsclerotized membranous side, distal end pointed with conspicuous recurved ventral barb (Fig. 68B).

Females: 8.70–12.65 long, 0.085–0.115 maximum width. Spination begins 0.080–0.113 from anterior end, extending to posterior 3rd of body to within short distance of anus; 59 to 69 rows of spines discerned in oesophageal region. Nerve ring 0.155–0.180 from anterior end. Prostom plus buccal cavity 0.130–0.140, muscular oesophagus 0.405–0.555, and glandular oesophagus 2.350–2.880 long. Amphidelphic, each arm of reproductive system consisting of coiled, looped ovary, followed by looping oviduct, seminal receptacle, uterus, anterior arm of system looping near oesophago-intestinal junction, loops of posterior ovary reaching near anus (Fig. 68C). Uteri

voluminous. Muscular vagina posteriorly directed, 0.225–0.290 long. Vulva inconspicuous, its opening transversely ovoid or slit-like, post-equatorial (Fig. 68D). Eggs 0.035–0.040 long, 0.018–0.025 wide, without surface ornamentation or filaments; terminal uterine eggs contain coiled larvae. Anus 0.117–0.142 from posterior end; tail apparently unspined, tapering to terminal heart-shaped mucron set off from body by narrow constriction. Phasmids ventro-lateral near tail tip (Fig. 68C).

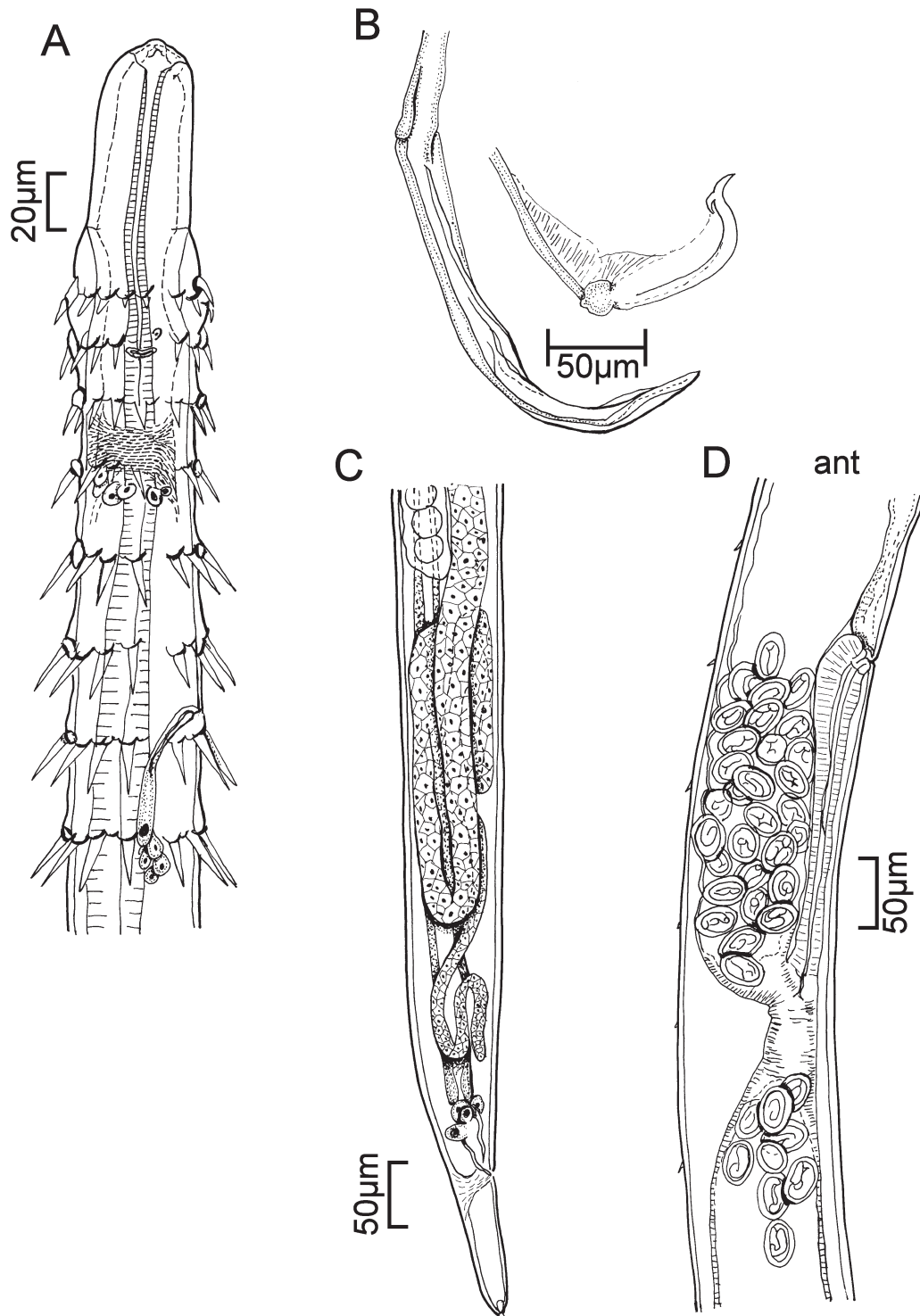


FIGURE 68. *Spinitectus macrospinosus* Choudhury & Perryman, 2003. A. female, anterior region, lateral view; B. right spicule [top], left spicule [bottom]; C. female, posterior region showing ovary and oviduct; D. female, vaginal region. (Redrawn from Choudhury & Perryman 2003)

Site: intestinal lumen

Hosts: *Ictalurus punctatus*; *Hiodon alosoides* (immature worms only); *Noturus flavus* (immature worms only)

Distribution: Manitoba

Record: Choudhury & Perryman 2003

Comment: Moravec *et al.* (2009) claimed that *Spinitectus macrospinosus* Choudhury & Perryman, 2003 is a junior synonym of *Spinitectus tabascoensis* Moravec, García-Magaña & Salgado-Maldonado, 2002. However, morphological, morphometric and geographical differences between the two species suggest that further morphological and molecular studies should be undertaken before the synonymy is accepted (A. Choudhury, pers. comm.).

***Spinitectus* sp.**

Site: alimentary tract

Hosts: *Acipenser fulvescens* (7, 9); *Anguilla rostrata* (12); *Macrourus berglax* (8, 10); *Perca flavescens* (1, 2, 4, 5, 6, 13); *Sander vitreus* (3, 4); *Urophycis tenuis* (11)

Distribution: Atlantic, Manitoba, Ontario, Saskatchewan

Records: Bangham 1941 (ON); 2. Bangham 1951 (ON); 3. Bangham 1955 (ON); 4. Dickson 1964 (MB); 5. Tedla 1969 (ON); 6. Tedla & Fernando 1972 (ON); 7. Anthony 1974 (ON); 8. Redkozubova 1976 (AT); 9. Anthony 1977 (ON); 10. Houston & Haedrich 1986 (AT); 11. Scott 1987 (AT); 12. Dechtiar & Christie 1988 (ON); 13. Carney & Dick 1999 (MB)

Family HEDRURIDAE Railliet, 1916

See Comments under Superfamily Habronematoidea above.

****Hedruris* sp.**

Site: intestinal lumen

Host: *Fundulus diaphanus*

Distribution: Nova Scotia

Record: Wiles, 1975

Family TETRAMERIDAE Travassos, 1914

See Comments under Superfamily Habronematoidea above.

****Tetrameres* sp.**

Site: ?

Host: *Chrosomus eos*

Distribution: Quebec

Record: Dubois *et al.*, 1996

Superfamily ACUARIOIDEA Railliet, Henry & Sisoff, 1912

Acuariidae is the only Family recognised within the Superfamily Acuarioidea (Anderson, 2000). The Family is

represented in Canadian fishes mainly by larvae of three members of the Subfamily Acuariinae Railliet, Henry and Sisoff, 1912, namely, **Cosmocephalus obvelatus*, **Paracuaria adunca* and **Syncuaria squamata*. The only other acuariid record is that of G. A. Black (1981a) who listed a larva representing the Subfamily Seuratiinae from *Salvelinus fontinalis* in Quebec; the record is included here for the sake of completeness, although no morphological details were provided.

Adult acuariines inhabit the upper alimentary tract mainly of birds. Those that parasitize aquatic final hosts, as in the present cases, develop to L3 in the haemocoel of aquatic crustaceans (amphipods and ostracods for example). Various forage and piscivorous fish species serve as paratenic hosts of L3.

Adults of the three genera (*Cosmocephalus*, *Paracuaria*, *Syncuaria*) are distinguished by the structure of cephalic ornamentations (the cordons) and deirids. These features are not fully developed at the L3 stage so design of a key for their identification is impossible.

Family ACUARIIDAE Railliet, Henry & Sisoff, 1912

Subfamily ACUARIINAE Railliet, Henry & Sisoff, 1912

****Cosmocephalus obvelatus* (Creplin, 1825) Seurat, 1919**

Description (after Wong & Anderson 1982). In the apparent absence of a description of L3 from fishes the following is based on Wong & Anderson's (1982) account of L3 from experimentally infected amphipods. L3 are 2.05 (1.63–2.40) long, and 0.071 (0.058–0.095) wide. Head with two triangular pseudolabia and four submedian cephalic papillae (Fig. 69A). Amphids small. Buccal cavity long and narrow but expanded in oral region. Pair of inconspicuous deirids immediately behind nerve ring. Excretory pore opens 0.16 (0.14–0.19) from anterior end (Fig. 69B). Total oesophagus [muscular plus glandular portions] 1.15 (0.99–1.40) long. Rectum tubular with thick cuticle. Tail tip rounded. Pair of large phasmids subventrally (Fig. 69C). Genital primordium of males a simple tube lying free in pseudocoelom; that of females a similar tube but attached to body wall by vaginal primordium (Fig. 69D).

Site: mesenteries

Hosts: *Apeltes quadracus* (2); *Carassius auratus* (1); *Cottus* sp. (1); *Fundulus heteroclitus* (3); *Gasterosteus aculeatus* (1, 2); *Notropis hudsonius* (1); *Notropis* sp. (1); *Oncorhynchus mykiss* (1); *Osmerus mordax* (1); *Pungitius pungitius* (2, 3); *Semotilus atromaculatus* (1)

Distribution: Nova Scotia, Ontario

Records: 1. Wong & Anderson 1982 (EX, ON); 2. Marcogliese 1992b (NS); 3. Marcogliese 1995b (NS)

****Paracuaria adunca* (Creplin, 1846) Anderson & Wong, 1981**

Description (after Anderson & Wong 1982). In the apparent absence of a description of L3 from fishes the following is based on Anderson & Wong's (1982) account of L3 from experimentally infected amphipods. L3 slender and delicate, 2.60 (2.20–2.80) long, 0.074 (0.070–0.090) wide. Cuticle transversely striated. Head with prominent triangular pseudolabia. Interlabia each divided into two equal lobes. Two pairs cephalic papillae submedially at base of pseudolabia. Amphids inconspicuous. Buccal cavity narrow, widening at oral opening and lined with thick cuticle. Deirids small, near nerve ring. Excretory pore opens 0.162 (0.14–0.19) from anterior end (Fig. 70A). Total oesophagus [muscular plus glandular] 1.25 (1.12–1.44) long. Rectum tubular and surrounded by three oval-shaped rectal cells with prominent nuclei. Tail with slight dorsal curve, and rounded tip. Inconspicuous phasmids located subventrally (Fig. 70B). Male genital primordium lies free in pseudocoelom; female primordium attached to body wall by vaginal primordium.

Site: mesenteries

Hosts: *Apeltes quadracus* (2); *Carassius auratus* (1); *Cottus* sp. (1); *Fundulus heteroclitus* (3); *Gasterosteus aculeatus* (1, 2); *Notropis hudsonius* (1); *Pungitius pungitius* (2, 3); *Semotilus atromaculatus* (1)

Distribution: Nova Scotia, Ontario

Records: 1. Anderson & Wong 1982 (EX, ON); 2. Marcogliese 1992b (NS); 3. Marcogliese 1995 (NS)

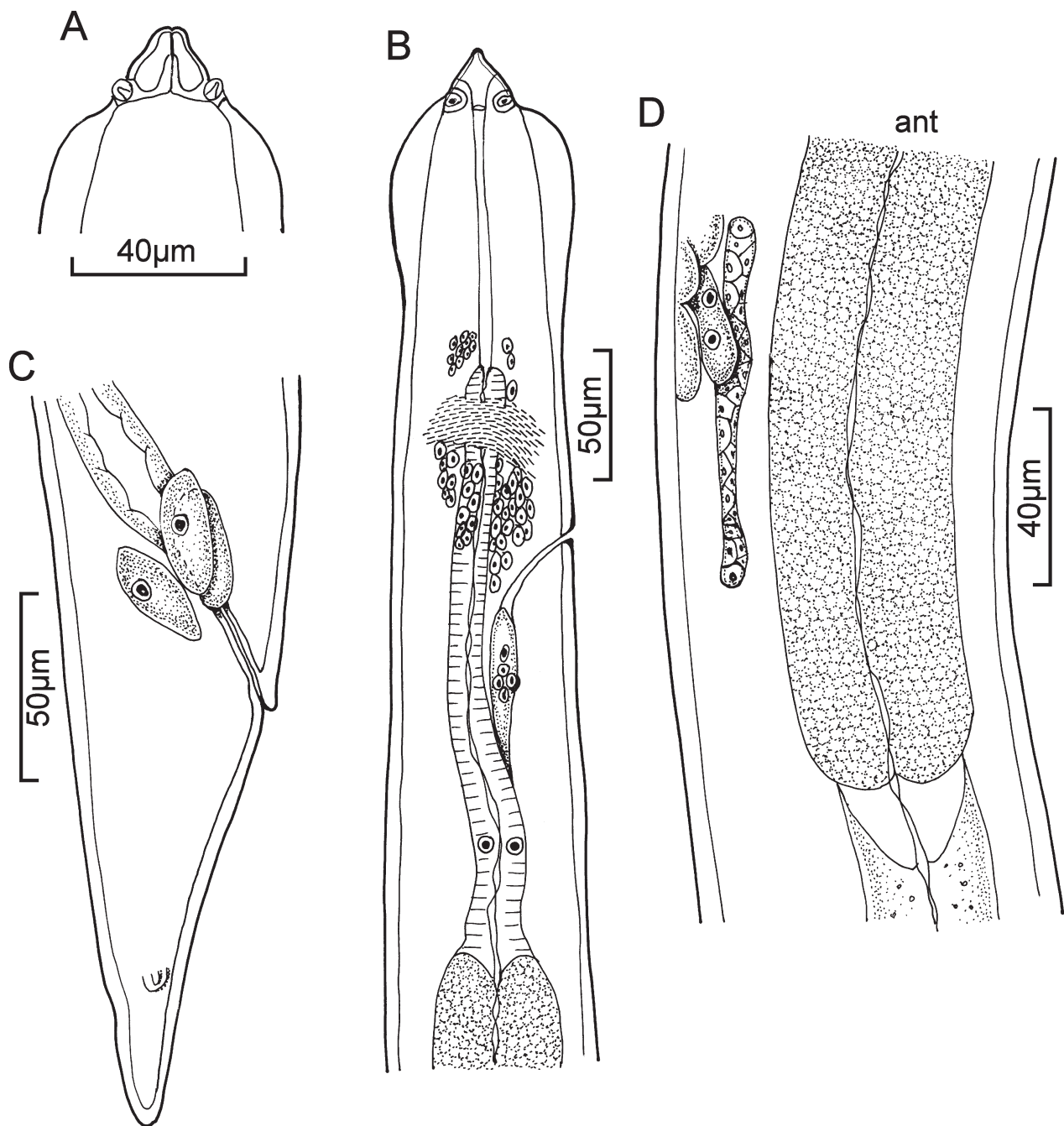


FIGURE 69. **Cosmocephalus obvelatus* (Creplin, 1825) Seurat, 1919. A. L3, head, dorso-ventral view; B. L3, anterior end, lateral view; C. L3, posterior end, lateral view; D. female L3, genital primordium, lateral view. (Redrawn from Wong & Anderson 1982)

****Syncuaria squamata* (Von Linstow, 1883) Gilbert, 1927**

Preamble: Eggs from *Syncuaria squamata* recovered by Wong & Anderson (1987) from Lake Ontarian cormorants were fed to ostracods. Granulomata containing L3 were found on the intestinal serosa of domestic goldfish *Carassius auratus* fed infected ostracods. Adult worms were recovered from a cormorant fed infected goldfish alimentary tracts. Although it appears that fish serve as paratenic hosts of *S. squamata*, no records have been traced of this nematode infecting wild fishes in Canadian waters. Because Wong & Anderson (*op. cit.*) did not describe the L3 from goldfish the following description is based on the description they provided for L3 from ostracods.

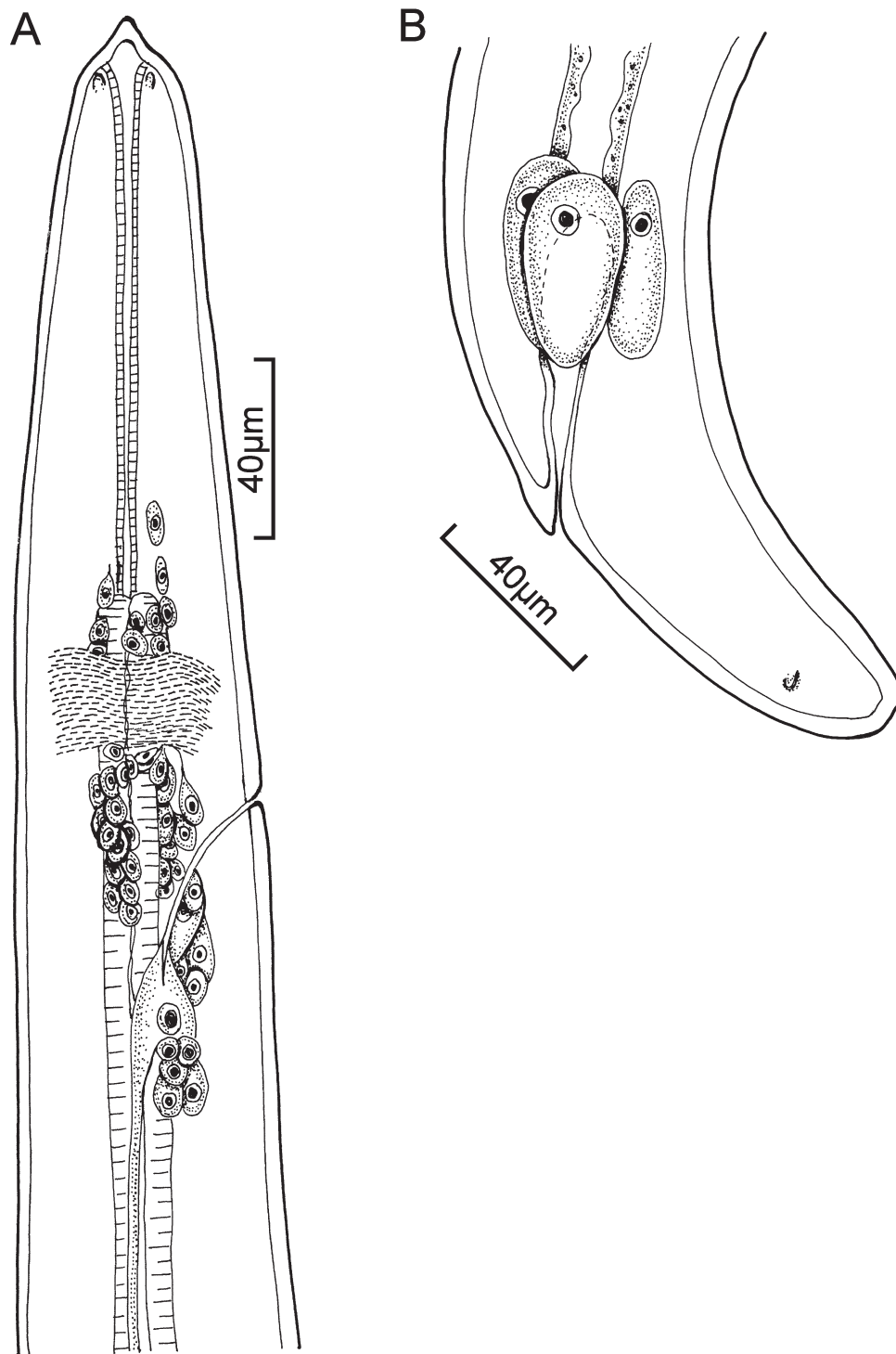


FIGURE 70. **Paracuaria adunca* (Creplin, 1846) Anderson & Wong, 1981. A. L3, anterior end, lateral view; B. L3, posterior end, lateral view. (Redrawn from Anderson & Wong 1982)

Description (after Wong & Anderson 1987). Pseudolabia well developed with prominent apices. Four interlabia originating at dorso-ventral sides of oral opening, surrounding pseudolabia and terminating at amphids. Four prominent cephalic papillae immediately behind interlabia. Buccal cavity elongated and expanded at oral opening (Fig. 71A). Deirids with pointed tips immediately behind excretory pore. Muscular oesophagus about one-fifth length of glandular oesophagus. Genital primordia present in males and females. Rectum elongated and anus patent. Tail with slight dorsal curve and rounded tip (Fig. 71B).

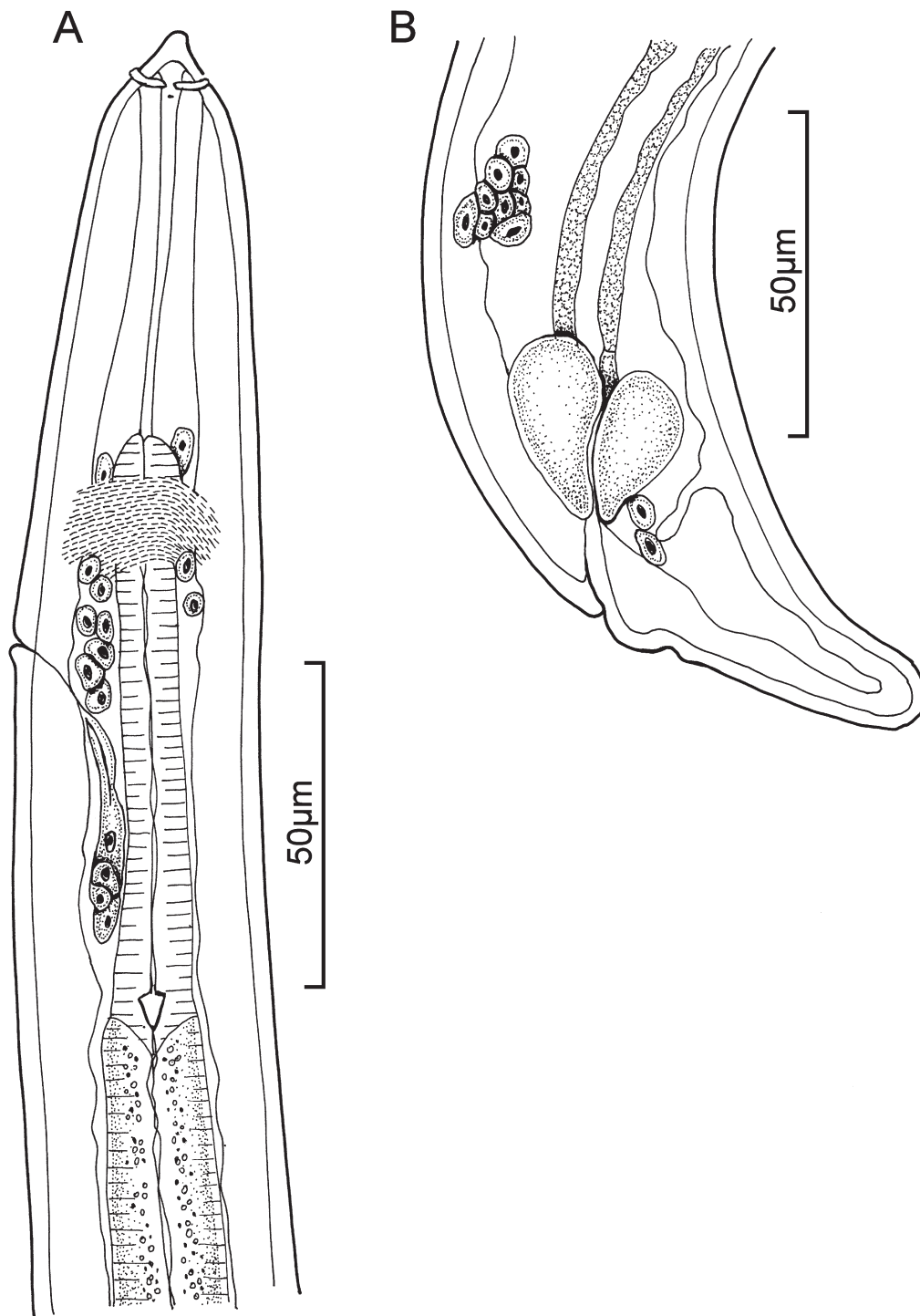


FIGURE 71. **Syncuaria squamata* (von Linstow, 1883) Gilbert, 1927. A. L3 [sex?], anterior end, lateral view ; B. female L3, posterior end showing genital primordium, lateral view. (Redrawn from Wong & Anderson 1987)

Male L3: 1.20 (0.98–1.38) long, 0.049 (0.040–0.058) wide. Excretory pore 0.102 (0.090–0.122) from anterior end. Total oesophagus (muscular plus glandular) 0.612 (0.512–0.712) long.

Female L3: 1.14 (1.04–1.38) long, 0.047 (0.040–0.065) wide. Excretory pore 0.098 (0.080–0.105) from anterior end. Total oesophagus (muscular plus glandular) 0.583 (0.485–0.726) long.

Site: intestinal serosa

Host: *Carassius auratus* (EX)

Distribution: Ontario

Record: Wong & Anderson 1987

***Seuratiinae gen. sp.**

Site: alimentary tract

Host: *Salvelinus fontinalis*

Distribution: Quebec

Record: G. A. Black 1981a

Infraorder ASCARIDOMORPHA De Ley & Blaxter, 2002

Key to Superfamilies of ASCARIDOMORPHA

- 1 Lips absent, or markedly reduced and variable; mouth opening sometimes elongated dorso-ventrally; oesophagus short, simple and cylindrical, or short and divided into two portions having or not having same width; pharyngeal portion of oesophagus present or absent; pre-cloacal sucker may be present in male; less than 11 pairs of genital papillae in male Seuratoidea
- With three well defined lips, usually large, sometimes separated by interlabia; oesophagus simple and cylindrical or terminated by swelling without valves; intestinal caeca present or absent; pre-cloacal sucker absent in male; genital papillae in male numerous Ascaridoidea

Superfamily ASCARIDOIDEA Railliet & Henry, 1915

“Morphospecies”, “cryptic species” and “sibling species” occur amongst marine ascaridoids that represent the Family Anisakidae (see also Pérez-Ponce de León & Nadler 2010). The larvae of some anisakids (species of *Anisakis* and *Pseudoterranova* in particular) have considerable public health and economic significance (J. W. Smith & Wootten 1978; Bowen 1990; Desportes & McClelland 2001).

Key to Families of ASCARIDOIDEA

- 1 Oesophagus comprising a preventriculus and an oblong to globular ventriculus with one dorsal and one ventral longitudinal suture-like depression, or with small globular ventriculus from which arises a posteriorly directed appendix with such depressions or rarely two appendices; excretory system asymmetrical, confined to left lateral chord; excretory pore situated between base of subventral lips or near nerve ring; intestinal caecum present or absent. Parasitic in mammals, birds, reptiles and fishes Anisakidae
- Oesophagus without ventriculus or with globular to ellipsoidal ventriculus without longitudinal sutures; excretory system symmetrical, the right lateral canal of which may be somewhat reduced; excretory pore near nerve ring; intestinal caecum present or absent; lips small, semicircular, not offset from anterior end; each lip provided on inner surface with two pairs of small pointed teeth, a continuous dentigerous ridge or two separate transverse dentigerous ridges; interlabia absent; oesophagus with ventriculus; intestinal caecum absent. Parasitic in elasmobranch fishes Acanthocheilidae

Family ACANTHOCHEILIDAE Wülker, 1929

This Family appears to be represented in Canadian fishes by only one genus and species, namely *Pseudanisakis tricupola*.

***Pseudanisakis* Layman & Borovkova, 1926**

Synonyms: *Eustoma* van Beneden, 1871; *Anacanthocheilus* Wülker, 1930; *Pseudanisakis* Yamaguti, 1941; *Metanisakis* Mozgovoi, 1950

Generic diagnosis (after Gibson 1973). Acanthocheilidae. One dorsal lip and two subventral lips (Fig. 72A), each with two papillae. Interlabia absent. Amphid present on subventral lips. Oesophagus long and narrow. Ventriculus oval or oblong, not round (Fig. 72B). Ventricular appendix and intestinal caecum absent. Excretory pore just

posterior to nerve ring. Anal glands absent. Male tail conical; normally six to nine pre-cloacal papillae on each side with five ad-cloacal or post-cloacal pairs of papillae. Spicules equal. Ejaculatory duct distinct and glandular; gubernaculum absent (Fig. 72C). Male *P. tricupola* from *Amblyraja radiata* 5.9–57.0 long. Female tail tapers to sharp point (Fig. 72D). Vulva situated in anterior half of body posterior to the ventriculus. Female *P. tricupola* from *A. radiata* are 5.9–34.5 long. Parasites of rays.

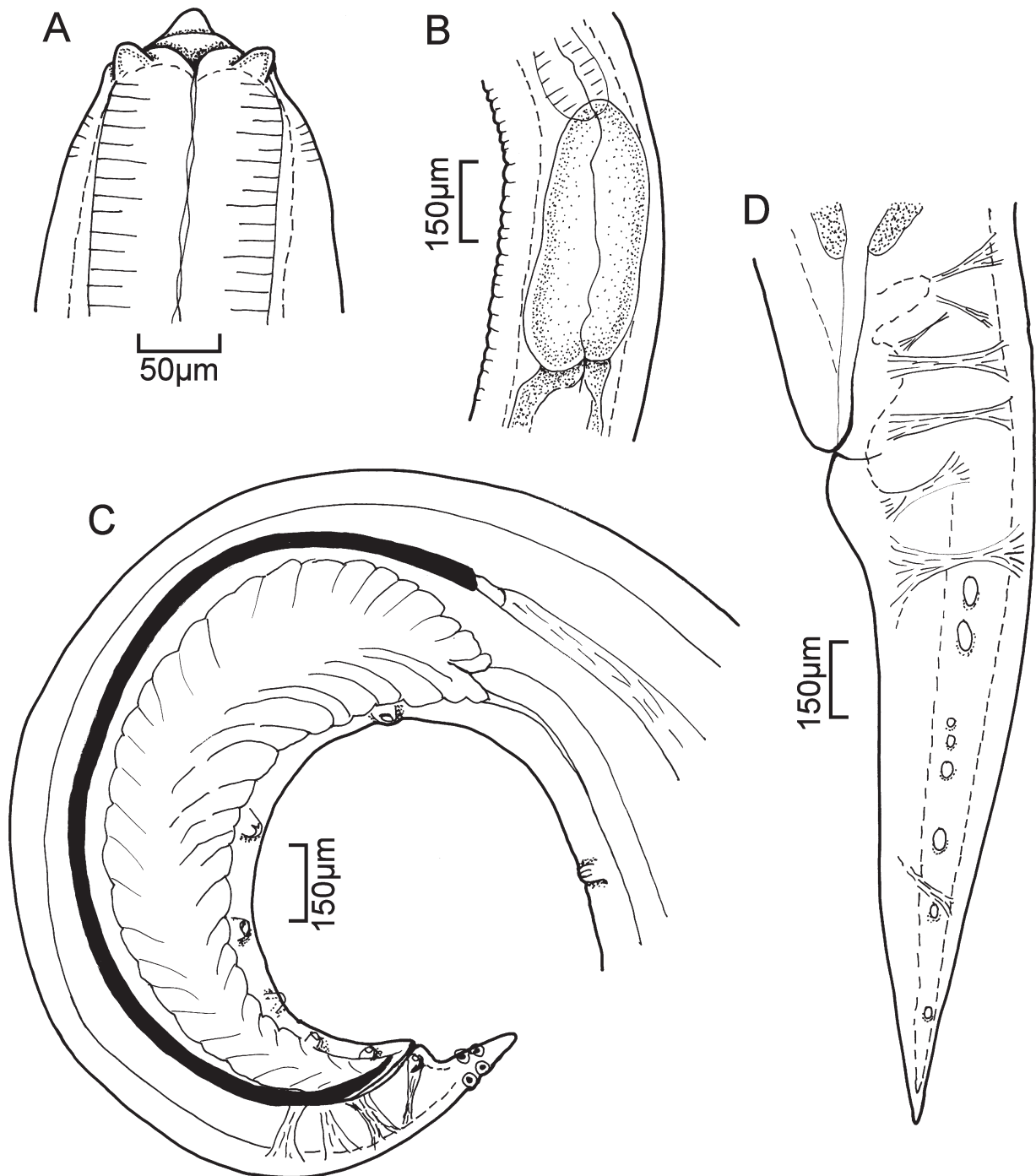


FIGURE 72. *Pseudanisakis tricupola* Gibson, 1973. A. head; B. ventriculus; C. male, posterior end, lateral view; D. female, posterior end, lateral view. (Redrawn from Gibson 1973)

***Pseudanisakis tricupola* Gibson 1973**

Sites: spiral valve, stomach

Hosts: *Amblyraja radiata* (2, 3, 4); *Dipturus laevis* (2); *Leucoraja erinacea* (1, 4); *Leucoraja ocellata* (2); *Squalus acanthias* (3)

Distribution: Atlantic

Records: 1. Heller 1949; 2. Myers 1959a; 3. Threlfall 1969; 4. Linkletter *et al.* 1977

****Pseudanisakis* sp.**

Synonym: **Eustoma* sp.

Sites: stomach, intestinal lumen

Host: *Raja* sp.

Distribution: Nova Scotia

Record: Scott & Black 1960

Family ANISAKIDAE Railliet & Henry, 1912

Key to Subfamilies of ANISAKIDAE

- 1 Excretory system ribbon-like, extending from left lateral chord into ventral part of body-cavity; excretory pore usually between subventral lips or at base of ventral interlabium; parasitic in mammals, birds, reptiles or elasmobranch fishes; larval stages in invertebrates and vertebrates, including fishes. Anisakinae
- Excretory system not ribbon-like; excretory pore usually near nerve ring; parasitic in fishes, occasionally birds Raphidascaridinae

Subfamily ANISAKINAE Railliet & Henry, 1912

Synonyms: Capsulariinae Johnston & Mawson 1943; Filocapsulariinae Yamaguti, 1961 in part; Stomachinae Johnston & Mawson 1945

Key to genera and tribes of ANISAKINAE

- 1 Oesophagus comprising preventriculus and an oblong to globular ventriculus; ventricular appendix absent; intestinal caecum present or absent; parasitic in marine mammals, marine turtles or elasmobranch fishes; marine fishes and cephalopods harbour third-stage larvae (L3). Anisakinae Chabaud, 1965 ...2
- Oesophagus comprising preventriculus and a reduced globular ventriculus giving off elongated ventricular appendix; intestinal caecum present; parasitic in marine, semi-aquatic or terrestrial mammals, or fish-eating birds Contracaecinae Mozgovoi & Shakhmatova, 1971 ...3
- 2 Intestinal caecum absent *Anisakis*
- Intestinal caecum present *Pseudoterranova*
- 3 Interlabia present *Contracaecum*
- Interlabia absent *Phocascaris*

****Anisakis simplex* (Rudolphi, 1809) Dujardin, 1845 (*sensu lato*)**

Includes **Anisakis simplex* B and C *auct*

Description (after Beverley-Burton *et al.* 1977, J. W. Smith 1983, and J. W. Smith & Wootten 1984b). With characteristics of the genus. Off-white in colour, L3 lie in capsules coiled like a watch-spring. From 8.8 to over 30 long. Cuticle usually transversely striated near anterior and posterior extremities. Mouth triangular with bilobed dorsal lip and two bilobed ventro-lateral lips, each lip with pair of indistinct papillae. Anteroventrally projecting boring tooth located ventral to mouth (Fig. 73A,B,C). Excretory pore between ventro-lateral lips with single duct passing up from excretory cell (Fig. 73A,B). Dorsal oesophageal gland extends just anterior to nerve ring. Two small ventro-lateral glands near posterior end of oesophagus. Oesophagus comprises preventriculus and

ventriculus. Ventral side of ventriculus slightly longer than dorsal side (Fig. 73A). Intestinal-rectal valve short, lined externally by four epithelial cells. Three rectal glands, two dorsal and one ventral. Tail rounded with retractable mucron (Fig. 73D). Length of preventriculus and ventriculus linearly related to total body length. Mean length of thirty L3 from one fish host was 22.6 (range 18.0–22.9), mean preventriculus length 1.94, and mean ventriculus length 0.89.

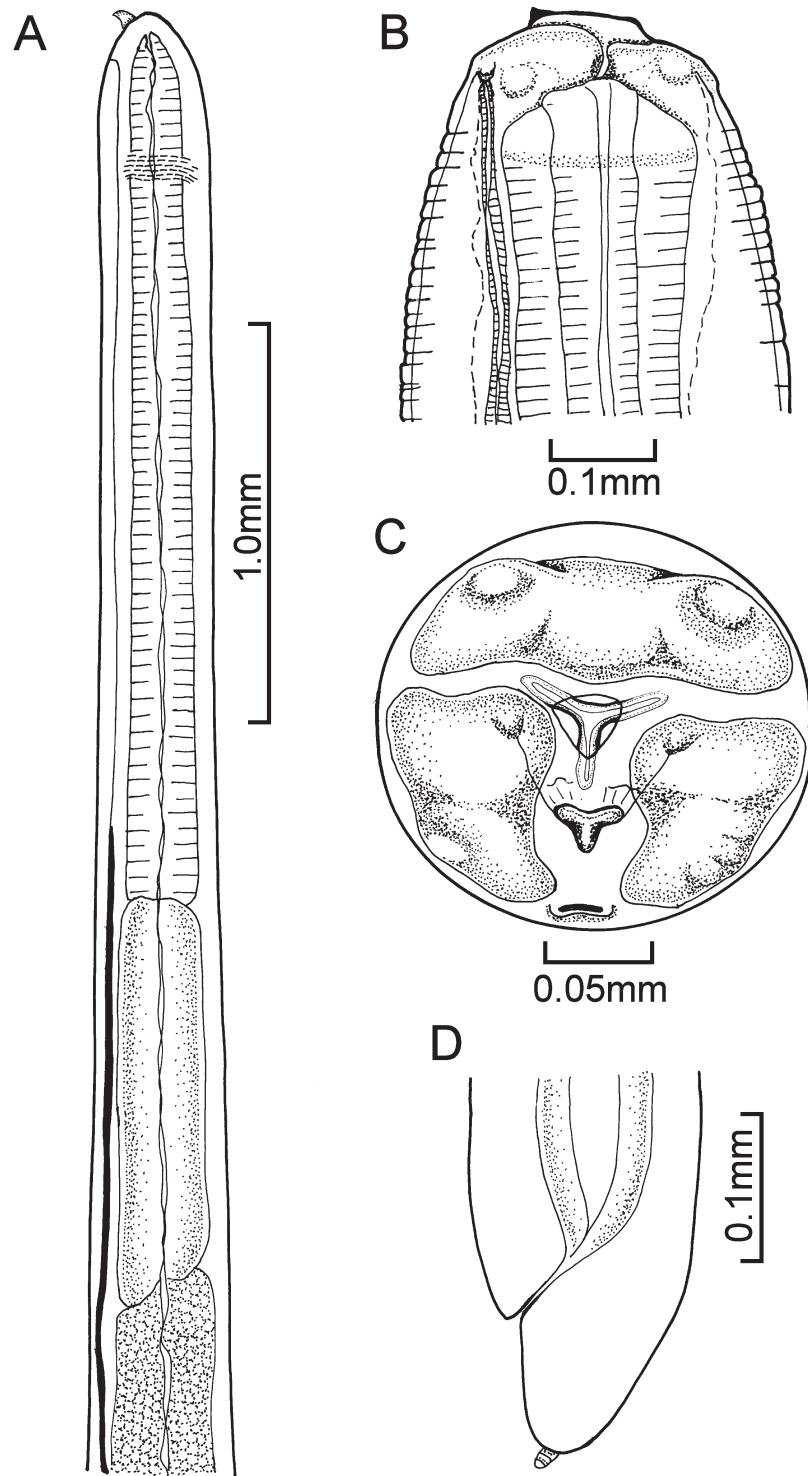


FIGURE 73. **Anisakis simplex* (Rudolphi, 1809) Dujardin, 1845 (*sensu lato*). A. L3, anterior end, lateral view; B. L3, head, sagittal view; C. L3, head, *en face* view D. L3, tail, lateral view. (A. and D. redrawn from J. W. Smith & Wootten 1984b; B. and C. redrawn from Beverley-Burton *et al.* 1977)

Sites: body cavity, alimentary tract, mesenteries, musculature

Hosts: *Acipenser transmontanus* (33); *Alosa aestivalis* (57); *Alosa pseudoharengus* (6, 57); *Amblyraja radiata* (49); *Ammodytes dubius* (28, 49); *Argentina silus* (49); *Atheresthes stomias* (76); *Boreogadus saida* (70, 73, 83); *Brosme brosme* (49); *Clupea harengus* (2, 4, 6, 7, 19, 25, 30, 32, 34, 35, 41, 54, 65, 68, 70, 72, 74); *Clupea pallasii* (8, 11, 12, 13, 73); *Coregonus huntsmani* (83); *Cyclopterus lumpus* (49); *Gadus macrocephalus* (74); *Gadus morhua* (17, 27, 28, 29, 36, 41, 42, 48, 49, 55, 60, 61, 64, 70, 73, 80, 82); *Gadus macrocephalus* (65); *Glyptocephalus cynoglossus* (28, 36, 49, 65); *Hemitripterus americanus* (49, 65); *Hippoglossoides platessoides* (28, 31, 36, 40, 63, 64); *Hippoglossus hippoglossus* (36, 49, 74); *Hippoglossus stenolepis* (67, 71, 78); *Limanda ferrugineus* (36, 49, 63, 65); *Lophius americanus* (49); *Lycodes* spp. (65); *Mallotus villosus* (26, 37, 62, 65, 72); *Melanogrammus aeglefinus* (36, 49); *Merluccius bilinearis* (6, 36, 65); *Merluccius productus* (5, 22); *Microgadus tomcod* (83); *Myoxocephalus octodecemspinosus* (65, 83); *Myoxocephalus scorpius* (65, 83); *Nezumia bairdii* (65); *Oncorhynchus gorbuscha* (74); *Oncorhynchus keta* (74); *Oncorhynchus mykiss* (24); *Oncorhynchus tshawytscha* (75); *Peprilus triacanthus* (49); *Phycis chesteri* (49); *Pollachius virens* (36, 49, 65); *Pseudopleuronectes americanus* (36, 49, 63, 65, 77, 80); *Reinhardtius hippoglossoides* (16, 43, 49, 50, 51, 52, 53, 56, 58, 59, 65, 69, 70, 73); *Salmo salar* (1, 2, 3, 4, 7, 9, 10, 14, 19, 70, 73, 83, 84); *Salvelinus alpinus* (83); *Salvelinus fontinalis* (15, 38, 39); *Scomber scombrus* (6, 19, 36, 49); *Scomberesox saurus* (70, 73); *Scophthalmus aquosus* (49); *Sebastes fasciatus* (49, 66); *Sebastes mentella* (49, 66, 79); *Sebastes* spp. (36, 65); *Squalus acanthias* (49); *Theragra chalcogramma* (18, 20, 23, 68, 70, 73, 74); *Urophycis chuss* (49); *Urophycis tenuis* (49, 65, 81); *Xiphias gladius* (21); unspecified “fish” (44, 45, 46, 47); *Zoarces americanus* (65)

Distribution: Atlantic, British Columbia, New Brunswick, Newfoundland, Nunavut, Pacific, Quebec

Records: 1. Nyman & Pippy 1972 (AT); 2. Pippy 1973a (AT); 3. Pippy 1973b (AT); 4. Beverley-Burton *et al.* 1977 (AT); 5. Margolis & Beverley-Burton 1977 (PA); 6. Gaevskaya & Umnova 1977 (AT); 7. Beverley-Burton & Pippy 1977 (AT); 8. Arthur 1978 (PA); 9. Beverley-Burton 1978b (AT); 10. Beverley-Burton & Pippy 1978 (AT); 11. Arthur & Arai 1979 (PA); 12. Arthur & Arai 1980a (PA); 13. Arthur & Arai 1980b (PA); 14. Pippy 1980 (AT); 15. G. A. Black 1981a (QC); 16. Reimer 1981 (NU); 17. Appy & Burt 1982 (AT); 18. Arthur *et al.* 1982 (PA); 19. Threlfall 1982 (AT); 20. Arthur 1983 (PA); 21. Hogans *et al.* 1983 (AT); 22. Sankurathri *et al.* 1983 (PA); 23. Arthur 1984 (PA); 24. Margolis 1984 (PA); 25. McGladdery 1984 (AT); 26. Pálsson & Beverley-Burton 1984 (AT); 27. Khan 1985 (AT); 28. McClelland *et al.* 1985 (AT); 29. Wells *et al.* 1985 (AT); 30. McGladdery & Burt 1985 (AT); 31. Zubchenko 1985a (AT); 32. Chenoweth *et al.* 1986 (AT); 33. Margolis & McDonald 1986 (PA); 34. McGladdery 1986a (AT); 35. McGladdery 1986b (AT); 36. Morrison *et al.* 1986 (AT); 37. Pálsson 1986 (AT); 38. Frimeth 1987a (NB); 39. Frimeth 1987b (NB); 40. McClelland *et al.* 1987 (AT); 41. Bratney 1988 (AT); 42. Chandra & Khan 1988 (AT); 43. Wierzbicka 1988 (AT); 44. Berland *et al.* 1989 (AT); 45. Burt *et al.* 1989a (AT); 46. Mattiucci & Paggi 1989 (AT); 47. Burt *et al.* 1989b (AT); 48. Bratney *et al.* 1990 (AT); 49. McClelland *et al.* 1990 (AT); 50. Wierzbicka 1991a (AT); 51. Wierzbicka 1991b (AT); 52. Arthur & Albert 1992a (AT); 53. Arthur & Albert 1992b (AT); 54. Bradford & Iles 1992 (AT); 55. Bratney & Bishop 1992 (AT); 56. Krzykowski & Wierzbicka 1992 (AT); 57. Landry *et al.* 1992 (AT); 58. Arthur & Albert 1993 (AT); 59. Arthur & Albert 1994 (AT); 60. Marcogliese & Boily 1994 (AT); 61. McClelland & Marcogliese 1994 (AT); 62. Arthur *et al.* 1995 (AT); 63. Martell & McClelland 1995 (AT); 64. Boily & Marcogliese 1995 (AT); 65. Marcogliese 1995a (AT); 66. Moran *et al.* 1996 (AT); 67. Blaycock 1996 (PA); 68. Mattiucci *et al.* 1996 (PA); 69. Boje *et al.* 1997 (AT); 70. Mattiucci *et al.* 1997 (AT, PA); 71. Blaycock *et al.* 1998a (PA); 72. Hays *et al.* 1998 (AT); 73. Paggi *et al.* 1998a (AT, PA); 74. Paggi *et al.* 1998b (PA); 75. Urawa *et al.* 1998 (PA); 76. Wierzbicka & Piasecki 1998 (PA); 77. Khan 1999 (AT); 78. Blaycock *et al.* 2003 (PA); 79. Marcogliese *et al.* 2003 (AT); 80. McClelland *et al.* 2005 (AT); 81. Melendy *et al.* 2005 (AT); 82. McClelland & Melendy 2011 (AT); 83. Pufall *et al.* 2012 (NU); 84. Larrat *et al.* 2013 (QC).

**Anisakis* sp.

Includes “*Anisakis*-type larva” *auct.*; “herringworm”; “whaleworm”

Sites: alimentary tract, body cavity, mesenteries, musculature, viscera

Hosts: *Acipenser transmontanus* (3); *Alepocephalus agassizii* (67); *Alosa aestivalis* (70); *Alosa pseudoharengus* (70); *Amblyraja radiata* (9, 28); *Ammodytes hexapterus* (23); *Anoplarchus purpureus* (23); *Anoplopoma*

fimbria (3); *Apodichthys flavidus* (23); *Atheresthes stomias* (2, 3, 24, 65, 81); *Aulorhynchus flavidus* (23); *Blepsias cirrhosus* (23); *Citharichthys sordidus* (3); *Citharichthys stigmaeus* (2, 18, 23); *Clupea harengus* (1, 4, 11, 12, 22, 25, 30, 33, 34, 37, 38, 39, 40, 42, 56); *Clupea pallasii* (3, 5, 18, 23, 45); *Coryphaenoides rupestris* (48, 53, 58, 59, 69); *Cryptacanthodes giganteus* (3); *Cyclopterus lumpus* (77); *Cymatogaster aggregata* (17, 19, 73); *Dipturus laevis* (9); *Eopsetta jordani* (2, 3, 16); *Gadus macrocephalus* (1, 16, 23); *Gadus morhua* (1, 8, 10, 13, 14, 52, 60, 61, 66, 80); *Gasterosteus aculeatus* (18, 23); *Glyptocephalus cynoglossus* (8, 54, 60); *Glyptocephalus zachirus* (3); *Hexagrammos lagocephalus* (18, 23); *Hippoglossoides elassodon* (3); *Hippoglossoides platessoides* (8, 54, 60, 61); *Hippoglossus hippoglossus* (50, 54); *Icosteus aenigmaticus* (3); *Isopsetta isolepis* (3); *Leptocottus armatus* (23); *Leucoraja ocellata* (9); *Lycodes brevipes* (3); *Lyopsetta exilis* (2, 3); *Macrourus berglax* (44, 58); *Mallotus villosus* (3, 8); *Melanogrammus aeglefinus* (8); *Merluccius albidus* (72); *Merluccius bilinearis* (72); *Merluccius productus* (3); *Microgadus tomcod* (1); *Microstomus pacificus* (2, 3, 65); *Myoxocephalus octodecemspinosus* (78); *Myoxocephalus polyacanthocephalus* (23); *Oligocottus maculosus* (23); *Oncorhynchus gorbuscha* (3, 6, 7, 18, 23, 45, 49, 55, 62); *Oncorhynchus keta* (3, 18, 23, 55, 62, 68, 75); *Oncorhynchus kisutch* (3, 45, 55, 62); *Oncorhynchus nerka* (3, 6, 7, 23, 55, 62); *Oncorhynchus tshawytscha* (3); *Ophiodon elongatus* (3, 23); *Osmerus mordax* (1, 57); *Parophrys vetulus* (2, 3, 65); *Pholis laeta* (23); *Pholis ornata* (18, 23); *Platichthys stellatus* (23); *Paraplagusia bilineata* (2, 3, 23); *Pollachius virens* (8); *Psettichthys melanostictus* (3); *Psychrolutes sigalutes* (23); *Raja rhina* (3); *Reinhardtius hippoglossoides* (50, 54); *Ronquilus jordani* (23); *Salmo salar* (1, 20, 21, 26, 27, 31, 41, 43); *Salvelinus alpinus* (43); *Salvelinus fontinalis* (43); *Scomber scombrus* (1); *Sebastes alutus* (18, 23); *Sebastes brevispinis* (3, 51); *Sebastes fasciatus* (64, 74); *Sebastes flavidus* (76, 79); *Sebastes mentella* (15, 64); *Sebastes norvegicus* (8, 15, 64); *Sebastes paucispinis* (3, 51); *Sebastes pinniger* (51); *Squalus acanthias* (3, 9, 28); *Syngnathus leptorhynchus* (18, 23); *Tautoglabrus adspersus* (32); *Theragra chalcogramma* (3, 23, 63, 65, 71); *Thunnus alalunga* (3); *Triglops pingelii* (18, 23); *Urophycis chuss* (1); *Urophycis tenuis* (72); unspecified “fish” (46); unspecified “herring” (29, 35, 36, 47)

Distribution: Atlantic, British Columbia, Labrador, New Brunswick, Nova Scotia, Pacific, Quebec

Records: 1. Heller 1949 (AT); 2. Margolis 1952a (PA); 3. Margolis 1952b (PA); 4. Scott 1953 (AT); 5. Bishop & Margolis 1955 (BC, PA); 6. Margolis 1956 (PA); 7. Margolis 1957 (BC, PA); 8. Templeman *et al.* 1957 (AT); 9. Myers 1959a (AT); 10. Scott & Martin 1959 (AT); 11. Sindermann 1959a (AT); 12. Sindermann 1959b (AT); 13. Fleming 1960 (AT); 14. Postolaki 1962 (AT); 15. Yanulov 1962 (AT); 16. Myers 1963 (AT); 17. Arai 1964 (PA); 18. Arai 1967a (PC); 19. Arai 1967b (PC); 20. Pippy 1967 (NB); 21. Templeman 1967 (AT); 22. Parsons 1968 (AT); 23. Arai 1969 (PA); 24. Kovalenko 1969 (PA); 25. Parsons 1969 (AT); 26. Pippy 1969 (AT, NB, NS, QC); 27. Power 1969 (QC); 28. Threlfall 1969 (AT); 29. Hodder & Parsons 1970 (AT); 30. Parsons 1970 (AT); 31. Pippy 1970 (AT); 32. Sekhar S. [*sic*] & Threlfall 1970 (AT); 33. Boyar & Perkins 1971 (AT); 34. Hodder & Parsons 1971a (AT); 35. Hodder & Parsons 1971b (AT); 36. Hodder & Parsons 1971c (AT); 37. Parsons 1971 (AT); 38. Parsons and Hodder 1971a (AT); 39. Parsons & Hodder 1971b (AT); 40. Parsons 1972 (AT); 41. Pippy 1972 (AT); 42. Dornheim 1973 (AT); 43. Hicks & Threlfall 1973 (LB); 44. Noble 1973 (PA); 45. Hoskins *et al.* 1976 (PA); 46. Redkozubova 1976 (AT); 47. Zenkin & Umnova 1976 (AT); 48. Zubchenko 1976 (AT); 49. Hoskins & Hulstein 1977 (BC); 50. Redkozubova 1978 (AT); 51. Cain & Raj 1980 (PA); 52. McClelland 1980c (AT); 53. Szuks 1980 (AT); 54. Zubchenko 1980 (AT); 55. Anon. 1981 (AT); 56. McGladdery 1981 (AT); 57. Threlfall 1981 (AT); 58. Zubchenko 1981a (AT); 59. Zubchenko 1981b (AT); 60. McClelland *et al.* 1983a (AT); 61. McClelland *et al.* 1983b (AT); 62. Anon. 1984 (BC); 63. Arthur 1984 (PA); 64. Bourgeois & Ni 1984 (AT); 65. Kabata & Whitaker 1984 (PA); 66. McClelland *et al.* 1984 (AT); 67. Zubchenko 1984 (AT); 68. Whitaker 1985 (PA); 69. Zubchenko 1985b (AT); 70. Landry *et al.* 1986 (AT); 71. Priebe 1986 (PA); 72. Scott 1987 (AT); 73. Arai *et al.* 1988 (PA); 74. Scott 1988 (AT); 75. Gardiner 1990 (PA); 76. Lee *et al.* 1990 (PA); 77. McClelland *et al.* 1990 (AT); 78. Khan 1991 (AT); 79. Stanley *et al.* 1992 (PA); 80. Lee & Khan 2000 (AT); 81. Adams *et al.* 2005 (PA)

****Pseudoterranova bulbosa* (Cobb, 1888) Mattiucci, Paggi, Nascetti, Ishikura, Kikuchi, Sato, Cianchi & Bullini, 1998**

Includes *P. decipiens* C auct.

Description: see that for *P. decipiens* below.

Site: ?

Hosts: *Gadus macrocephalus* (5); *Hippoglossus hippoglossus* (5); *Myoxocephalus quadricornis* (5); *Reinhardtius hippoglossoides* (3, 4); unspecified “fish” (1, 2)

Distribution: Atlantic, Labrador, Pacific

Records: 1. Berland *et al.* 1989 (LB); 2. Mattiucci & Paggi 1989 (LB); 3. Paggi *et al.* 1991 (AT); 4. Mattiucci *et al.* 1998 (AT); 5. Paggi *et al.* 1998b (AT, PA).

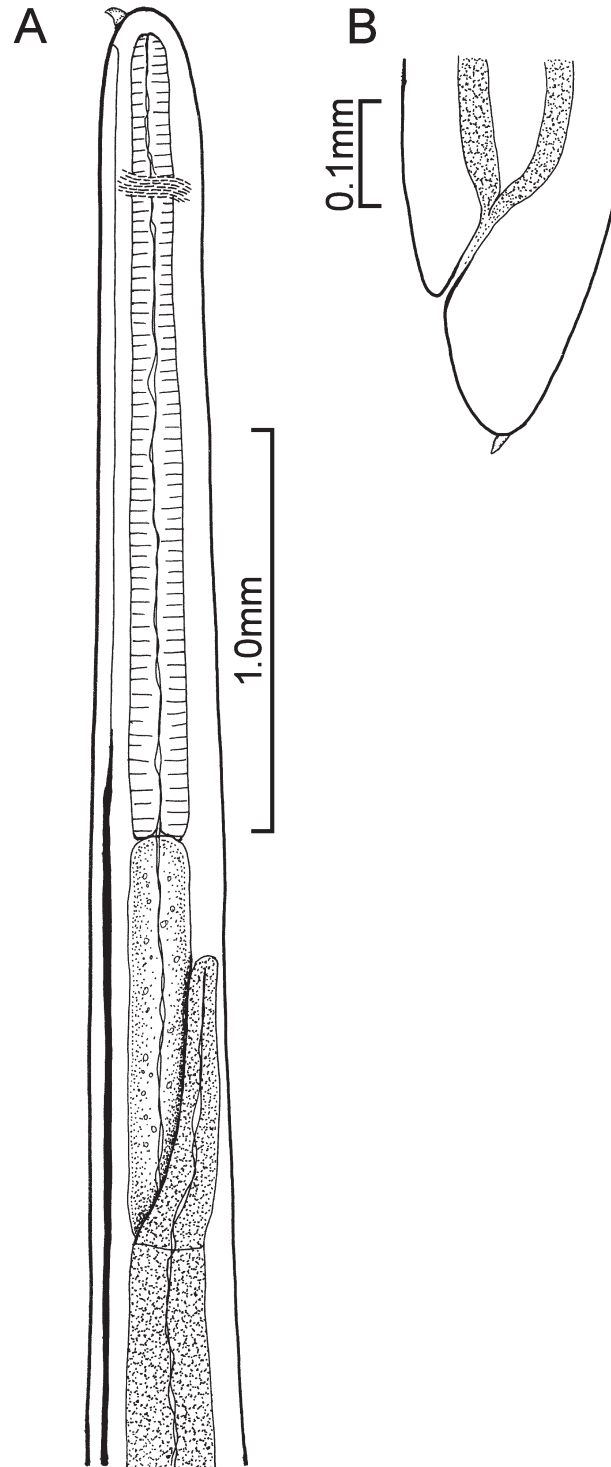


FIGURE 74. **Pseudoterranova decipiens* (Krabbe, 1878) Gibson, 1983 (*sensu lato*). A. L3, anterior end, lateral view; B. L3, tail, lateral view. (Redrawn from J. W. Smith & Wootten 1984a)

****Pseudoterranova decipiens* (Krabbe, 1878) Gibson, 1983 (*sensu lato*)**

Synonyms: *Terranova decipiens* (Krabbe, 1878) Mozgovoi, 1953; *Phocanema decipiens* (Krabbe, 1878) Myers 1959

Includes *P. decipiens* B auct.

Description (after McClelland & Ronald 1974, McClelland *et al.* 1983, Hurst 1984, J. W. Smith & Wootten 1984a, McClelland 1995, and Martell & McClelland 1995). With characteristics of the genus. Creamy white, yellow, brown, red, or reddish brown in colour, L3 lie coiled in capsules of irregular shape. About 1.5 to 60 long. Cuticular striations transverse and irregular. Anterior and posterior ends of an L3 shown diagrammatically in Fig. 74A,B. Mouth, lips, boring tooth, and excretory pore similar to those of *Anisakis simplex* L3 (see Fig. 73A,B,C). L3 from cod musculature 15–60 long, from cod viscera, mesenteries and peritoneum 8–42 long. The largest of five relatively small L3 found free in a flatfish stomach (from Canadian waters) was 8.078 long; length of pre-ventriculus, ventriculus, intestinal caecum and tail 0.871, 0.533, 0.194, and 0.105 respectively. The smallest of these L3 was 1.592 long; corresponding measurements 0.290, 0.158, not stated, and 0.066. Mean length of ten L3 from barracouta (from New Zealand waters) was 29.8 (range 25.0–36.0); corresponding measurements 2.03 (1.54–2.65), 0.90 (0.71–1.14), 1.11 (0.87–1.29), and 0.12 (0.10–0.13). Tail bluntly rounded with small mucron.

Sites: body cavity, mesenteries, musculature

Hosts: *Alosa aestivalis* (110); *Alosa pseudoharengus* (110, 127); *Amblyraja radiata* (99); *Ammodytes* sp. (99); *Anarhichas lupus* (55, 138); *Anoplopoma fimbria* (69); *Apeltes quadracus* (112, 113); *Arctediellus atlanticus* (138); *Aspidophoroides monopterygius* (99, 138); *Atheresthes stomias* (69, 134); *Boreogadus saida* (106, 145); *Brosme brosme* (99); *Clupea harengus* (56, 79); *Clupea pallasii* (43); *Coregonus huntsmani* (145); *Cryptacanthodes maculatus* (138); *Cyclopterus lumpus* (99, 138); *Enchelyopus cimbrius* (138); *Eumesogrammus praecisus* (138); *Eumicrotremus spinosus* (99, 138); *Fundulus heteroclitus* (127); *Gadus morhua* (1, 2, 3, 5, 6, 7, 8, 11, 14, 15, 17, 19, 21, 27, 28, 29, 30, 31, 32, 34, 35, 36, 37, 40, 44, 46, 49, 50, 51, 52, 53, 54, 58, 62, 63, 68, 71, 73, 74, 77, 79, 80, 81, 87, 89, 90, 92, 93, 99, 100, 101, 103, 104, 105, 106, 107, 111, 114, 116, 117, 118, 119, 121, 122, 124, 127, 129, 136, 138, 143, 144); *Gadus macrocephalus* (1, 6, 21, 106, 125); *Gasterosteus aculeatus* (113, 127); *Glyptocephalus cynoglossus* (1, 6, 10, 19, 46, 62, 63, 71, 73, 77, 99, 125, 138); *Hemitripterus americanus* (1, 6, 21, 46, 89, 92, 93, 99, 103, 105, 114, 125, 129, 138); *Hippoglossoides platessoides* (1, 5, 6, 10, 19, 21, 46, 55, 62, 63, 71, 73, 75, 77, 86, 99, 105, 114, 124, 126, 129, 136, 137, 138, 139); *Hippoglossus hippoglossus* (77, 99, 129); *Hippoglossus stenolepis* (43, 128, 133, 140); *Limanda ferrugineus* (6, 21, 45, 63, 71, 73, 77, 99, 105, 114, 125, 126, 138); *Lophius americanus* (99, 125, 138); *Lumpenus lumpretaeformis* (138); *Leptoclinus maculatus* (138); *Lycodes reticulatus* (138); *Lycodes vahlii* (99, 138); *Lycodes* spp. (125); *Mallotus villosus* (123); *Melanogrammus aeglefinus* (99, 105, 114, 138); *Menidia menidia* (127); *Merluccius bilinearis* (1, 99, 138); *Merluccius productus* (64); *Microgadus tomcod* (145); *Microstomus pacificus* (69); *Myoxocephalus aeneus* (127); *Myoxocephalus octodecemspinosus* (6, 21, 99, 105, 114, 125, 138, 145); *Myoxocephalus scorpius* (6, 21, 65, 106, 125, 129, 145); *Myoxocephalus* sp. (19); *Nezumia bairdii* (57); *Oncorhynchus mykiss* (70, 101, 102, 107); *Ophiodon elongatus* (43); *Osmerus mordax* (1, 5, 6, 21, 61, 85, 86, 89, 92, 95, 96, 97, 103, 127); *Peprilus triacanthus* (99, 138); *Phycis chesteri* (99); *Pollachius virens* (99, 106, 127); *Pseudopleuronectes americanus* (6, 77, 99, 105, 125, 126, 127, 135, 138, 141); *Raja* sp. (21); *Reinhardtius hippoglossoides* (60, 99, 108, 109, 115, 120, 125, 129, 132, 138); *Salmo salar* (127, 145); *Salvelinus alpinus* (145); *Salvelinus fontinalis* (93, 127); *Scophthalmus aquosus* (99, 105, 114, 138); *Sebastes alutus* (18, 24); *Sebastes fasciatus* (1, 99, 131, 138); *Sebastes flavidus* (98); *Sebastes mentella* (99, 131); *Sebastes norvegicus* (6, 45); *Tautoglabrus adspersus* (125, 127); *Theregra chalcogramma* (59, 67, 69, 78); *Triglops murrayi* (6, 138); *Triglops pingelii* (21); *Urophycis chuss* (99); *Urophycis tenuis* (6, 99, 125, 138, 142); unspecified “cod” (5, 9, 12, 13, 16, 20, 25, 33, 38, 39, 41, 42, 47, 48, 66, 72, 84, 94); unspecified “fish” (22, 23, 26, 76, 82, 83, 88, 91); unspecified “hake” (1); *Zoarcas americanus* (1, 5, 6, 21, 46, 92, 99, 125, 138)

Distribution: Atlantic, Newfoundland, Nova Scotia, Nunavut, Pacific

Records: 1. Scott 1950 (AT); 2. Baer 1953 (AT); 3. Martin 1953 (AT); 4. Reed 1953 (AT); 5. Scott 1953 (AT); 6. Scott 1954 (AT); 7. Ronald 1956 (AT); 8. Scott 1956 (AT); 9. W. F. Black 1957 (AT); 10. Homans & MacFarlane 1957 (AT); 11. Scott & Martin 1957 (AT); 12. Fairbairn 1958 (AT); 13. Power 1958 (AT); 14. Scott & Fisher 1958 (AT); 15. Kohler 1959 (AT); 16. Myers 1959b (AT); 17. Scott & Martin 1959 (AT); 18. Liston *et al.* 1960 (PA); 19. Myers 1960 (EX, AT); 20. Ronald 1960 (AT); 21. Scott & Black 1960 (AT); 22. Bradley 1961a (AT); 23. Bradley 1961b (AT); 24. Liston & Hitz 1961 (PA); 25. Power 1961 (AT); 26. Ronald

1962 (AT); 27. Freeman *et al.* 1963 (AT); 28. Townsley *et al.* 1963 (AT); 29. McCracken & Fitzgerald 1964 (AT); 30. Davey 1965 (AT); 31. Davey 1966 (AT); 32. Wiles 1968 (AT); 33. Kan & Davey 1968a (AT); 34. Kan & Davey 1968b (AT); 35. Davey 1969 (AT); 36. Pippy 1970 (AT); 37. Davey 1971 (AT); 38. Davey & Sommerville 1974 (AT); 39. McClelland & Ronald 1974 (AT); 40. Ackman & Gjelstad 1975 (AT); 41. Boghen & Davey 1975 (AT); 42. Ackman 1976 (AT); 43. Hoskins *et al.* 1976 (PA); 44. McClelland 1976 (AT); 45. Gaevskaya & Umnova 1977 (AT); 46. Linkletter *et al.* 1977 (AT); 47. Goil & Harpur 1978 (AT); 48. Davey 1979 (AT); 49. Goil & Harpur 1979 (AT); 50. Cain & Raj 1980 (AT); 51. Croll *et al.* 1980 (AT); 52. McClelland 1980a (AT); 53. McClelland 1980b (AT); 54. McClelland 1980c (AT); 55. Zubchenko 1980 (AT); 56. McGladdery 1981 (AT); 57. Zubchenko 1981a (AT); 58. Appy & Burt 1982 (AT); 59. Arthur *et al.* 1982 (PA); 60. Khan *et al.* 1982 (AT); 61. Fréchet *et al.* 1983 (AT); 62. McClelland *et al.* 1983a (AT); 63. McClelland *et al.* 1983b (AT); 64. Sankurathri *et al.* 1983 (PA); 65. Stewart & Bernier 1983 (NT); 66. Apold *et al.* 1984 (AT); 67. Arthur 1984 (PA); 68. Davey & Goh 1984 (AT); 69. Kabata & Whitaker 1984 (PA); 70. Margolis 1984 (PA); 71. McClelland *et al.* 1984 (AT); 72. Goh & Davey 1985 (AT); 73. McClelland *et al.* 1985 (AT); 74. Wells *et al.* 1985 (AT); 75. Zubchenko 1985a (AT); 76. Davey 1986 (AT); 77. Morrison *et al.* 1986 (AT); 78. Priebe 1986 (PA); 79. Bratney 1988 (AT); 80. Chandra & Khan 1988 (AT); 81. Lee 1988 (AT); 82. Berland *et al.* 1989 (AT); 83. Burt *et al.* 1989a (AT); 84. des Clers 1989 (AT); 85. Landry 1989a (AT); 86. Landry 1989b (AT); 87. Likely & Burt 1989 (AT); 88. Mattiucci & Paggi 1989 (AT); 89. Appleton & Burt 1990 (AT); 90. Bratney *et al.* 1990 (AT); 91. Burt *et al.* 1990a (AT); 92. Burt *et al.* 1990b (AT); 93. Burt *et al.* 1990c (EX, AT); 94. Burt *et al.* 1990d (AT); 95. Landry 1990a (AT); 96. Landry 1990b (AT); 97. Landry & Hare 1990 (AT); 98. Lee *et al.* 1990 (PA); 99. McClelland *et al.* 1990 (AT); 100. Myers & Bratney 1990 (AT); 101. Ramakrishna & Burt 1990 (EX, AT); 102. J. W. Smith *et al.* 1990 (EX, AT); 103. Appleton & Burt 1991 (AT); 104. des Clers 1991 (AT); 105. Marcogliese 1991 (AT); 106. Paggi *et al.* 1991 (AT); 107. Ramakrishna & Burt 1991 (EX, AT); 108. Arthur & Albert 1992a (AT); 109. Arthur & Albert 1992b (AT); 110. Landry *et al.* 1992 (AT); 111. MacKinnon & Burt 1992 (AT); 112. Marcogliese 1992a (NS); 113. Marcogliese 1992b (NS); 114. Marcogliese & McClelland 1992 (AT); 115. Arthur & Albert 1993 (AT); 116. Dixon *et al.* 1993 (AT); 117. Fusé *et al.* 1993a (AT); 118. Fusé *et al.* 1993b (AT); 119. Ramakrishna *et al.* 1993 (AT); 120. Arthur & Albert 1994 (AT); 121. Marcogliese & Boily 1994 (AT); 122. McClelland & Marcogliese 1994 (AT); 123. Arthur *et al.* 1995 (AT); 124. Boily & Marcogliese 1995 (AT); 125. Marcogliese 1995a (AT); 126. Martell & McClelland 1995 (AT); 127. McClelland 1995 (EX, AT); 128. Blaycock 1996 (PA); 129. Bratney & Davidson 1996 (AT); 130. Marcogliese 1996 (NS); 131. Moran *et al.* 1996 (AT); 132. Boje *et al.* 1997 (AT); 133. Blaycock *et al.* 1998a (PA); 134. Wierzbicka & Piasecki 1998 (PA); 135. Khan 1999 (AT); 136. McClelland 2000 (AT); 137. McClelland *et al.* 2000 (AT); 138. McClelland & Martell 2001a (AT); 139. McClelland & Martell 2001b (AT); 140. Blaycock *et al.* 2003 (PA); 141. McClelland *et al.* 2005 (AT); 142. Melendy *et al.* 2005 (AT); 143. Khan *et al.* 2011 (NF); 144. McClelland & Melendy 2011 (AT); 145. Pufall *et al.* 2012 (NU)

****Pseudoterranova* sp.**

Synonyms: “*Porrocaecum*-type” sp. *auct.*; *Phocanema* sp. *auct.*; “codworm”; “sealworm”

Sites: alimentary tract, body cavity, mesenteries, musculature, viscera

Hosts: *Amblyraja radiata* (15); *Anoplarchus purpureus* (13); *Anoplopoma fimbria* (4); *Atheresthes stomias* (14); *Gadus macrocephalus* (4); *Gadus morhua* (1, 3, 6, 8, 12, 18); *Gadus macrocephalus* (6); *Glyptocephalus cynoglossus* (6, 11); *Hippoglossoides platessoides* (6, 11); *Hippoglossus hippoglossus* (11); *Leucoraja ocellata* (9); *Limanda ferrugineus* (6, 11); *Lophius americanus* (6); *Melanogrammus aeglefinus* (6); *Microgadus tomcod* (6); *Myoxocephalus octodecemspinosus* (6); *Myoxocephalus polyacanthocephalus* (13); *Oncorhynchus nerka* (5); *Ophiodon elongatus* (4, 13); *Osmerus mordax* (6, 20); *Pleuronectes putnami* (11); *Pseudopleuronectes americanus* (11); *Raja* sp. (10); *Rhamphocottus richardsonii* (13); *Scophthalmus aquosus* (11); *Sebastes flavidus* (21); *Sebastes norvegicus* (6); *Squalus acanthias* (15); *Tautoglabrus adspersus* (17); *Theragra chalcogramma* (13); unspecified “cod” (2, 7, 16); unspecified “fish” (19)

Distribution: Atlantic, British Columbia, Canada, Pacific

Records: 1. Smedley 1934 (AT); 2. Needler 1947 (AT); 3. Heller 1949 (AT); 4. Margolis 1952b (PA); 5. Margolis 1957 (BC); 6. Templeman *et al.* 1957 (AT); 7. Crampton *et al.* 1960 (AT); 8. Fleming 1960 (AT); 9. Myers 1959a (AT); 10. Myers 1960 (AT); 11. Ronald 1963 (AT); 12. Wiles 1968 (AT); 13. Arai 1969 (PA); 14.

Kovalenko 1969 (PA); 15. Threlfall 1969 (AT); 16. Chitwood 1970 (CA); 17. Sekhar S. [sic] & Threlfall 1970 (AT); 18. Kates *et al.* 1973 (AT); 19. Redkozubova 1976 (AT); 20. Threlfall 1981 (AT); 21. Stanley *et al.* 1992 (PA)

***Anisakidae gen. sp.**

Sites: body cavity, intestinal lumen, mesenteries, peritoneum

Hosts: *Gadus morhua* (1); *Hippoglossus hippoglossus* (5); *Pollachius virens* (3); *Prosopium williamsoni* (2); *Pseudopleuronectes americanus* (6, 7); *Reinhardtius hippoglossoides* (5); *Salmo salar* (8); *Sebastes fasciatus* (4)

Distribution: Atlantic, British Columbia

Records: 1. Appy & Burt 1982 (AT); 2. Anon. 1984 (BC); 3. Scott 1985 (AT); 4. Scott 1988 (AT); 5. Scott & Bray 1989 (AT); 6. Khan *et al.* 1992 (AT); 7. Barker *et al.* 1994 (AT); 8. Marty 2008 (BC)

***Anisakinae gen. sp.**

Sites: mesenteries, musculature, stomach, viscera

Hosts: *Clupea harengus* (1, 2); *Glyptocephalus cynoglossus* (4); *Hippoglossoides platessoides* (4); *Hippoglossus hippoglossus* (4); *Limanda ferrugineus* (4); *Pleuronectes putnami* (4); *Pseudopleuronectes americanus* (4); *Scophthalmus aquosus* (4); *Sebastes fasciatus* (5); *Sebastes mentella* (5); *Sebastes norvegicus* (3)

Distribution: Atlantic

Records: 1. Sindermann 1957; 2. Sindermann 1961a; 3. Sindermann 1961b; 4. Ronald 1963; 5. Moran *et al.* 1996

Tribe CONTRACAECINEA: genera *Contracaecum* and *Phocascaris*

The species of these two genera are defined by characteristics of the adults. It is difficult therefore to assign larvae to any one species, and impossible to design a key for their reliable identification (Moravec 2013). Feeding experiments to rear larvae to adults and/or the application of molecular markers to aid identification of species may help solve these problems. Bratney (1995) used discriminant function analysis to reveal differences in shape among larvae of *Contracaecum* and *Phocascaris*. He reported that larvae of *Phocascaris* sp. and *C. osculatum* B can generally be distinguished by the use of three measurements (body length, and widths at mid-length and at the base of the intestinal caecum) although larvae of *C. osculatum* A could not be reliably distinguished from the other two species. The following taxa are included as their names have appeared in the relevant Canadian literature.

****Contracaecum osculatum* (Rudolphi, 1802) Baylis, 1920 (sensu lato)**

Includes: **C. osculatum* A auct.; **C. osculatum* B auct.; and **C. osculatum* C auct.

Description (after J. W. Smith & Wootten 1984c, and Moravec 2013). NB: the following description applies also to **Phocascaris* sp. and/or **Contracaecum* sp. (see below). Greenish brown in colour, sometimes tinged with red, L3 about 7 to 30 long, lying coiled in capsules of irregular shape (J. W. Smith & Wootten 1984c). Mouth, lips, boring tooth, and excretory pore similar to those of *Anisakis simplex* L3 (see Fig. 73A,B,C).

According to Moravec (2013), L3 are 3.81–22.00 long, maximum width 0.15–0.53. Oesophagus 0.55–1.71 long, ventricular appendix 0.54–1.58, and intestinal caecum 0.20–0.89. Single excretory cell extends posteriorly to mid-body region. Tail 0.09–0.21 long, narrows rapidly to a point lacking a mucron. Anterior and posterior ends of an L3 shown diagrammatically in Fig. 75A,B.

Sites: intestinal lumen, mesenteries, musculature, viscera

Hosts: *Boreogadus saida* (13); *Gadus macrocephalus* (11); *Gadus morhua* (1, 4, 5, 7, 8, 9, 10, 14, 16); *Glyptocephalus cynoglossus* (1); *Hippoglossoides platessoides* (10); *Hippoglossus hippoglossus* (11); *Mallotus villosus* (10); *Myoxocephalus scorpius* (10); *Oncorhynchus mykiss* (6); *Oncorhynchus tshawytscha* (12); *Pseudopleuronectes americanus* (10); *Theragra chalcogramma* (11); *Urophycis tenuis* (5, 15); unspecified “fish” (2, 3)

Distribution: Atlantic, Nunavut, Pacific

Records: 1. McClelland *et al.* 1985 (AT); 2. Berland *et al.* 1989 (AT); 3. Burt *et al.* 1989a (AT); 4. Bratney *et al.*

1990 (AT); 5. McClelland *et al.* 1990 (AT); 6. J. W. Smith *et al.* 1990 (EX, AT); 7. Likely & Burt 1992 (AT); 8. Marcogliese & Boily 1994 (AT); 9. McClelland & Marcogliese 1994 (AT); 10. Bratney 1995 (AT); 11. Paggi *et al.* 1998 (PA); 12. Urawa *et al.* 1998 (PA); 13. Køie 2009 (NU); 14. Khan *et al.* 2011 (AT); 15. Melendy *et al.* 2005 (AT); 16. McClelland & Melendy 2011 (AT)

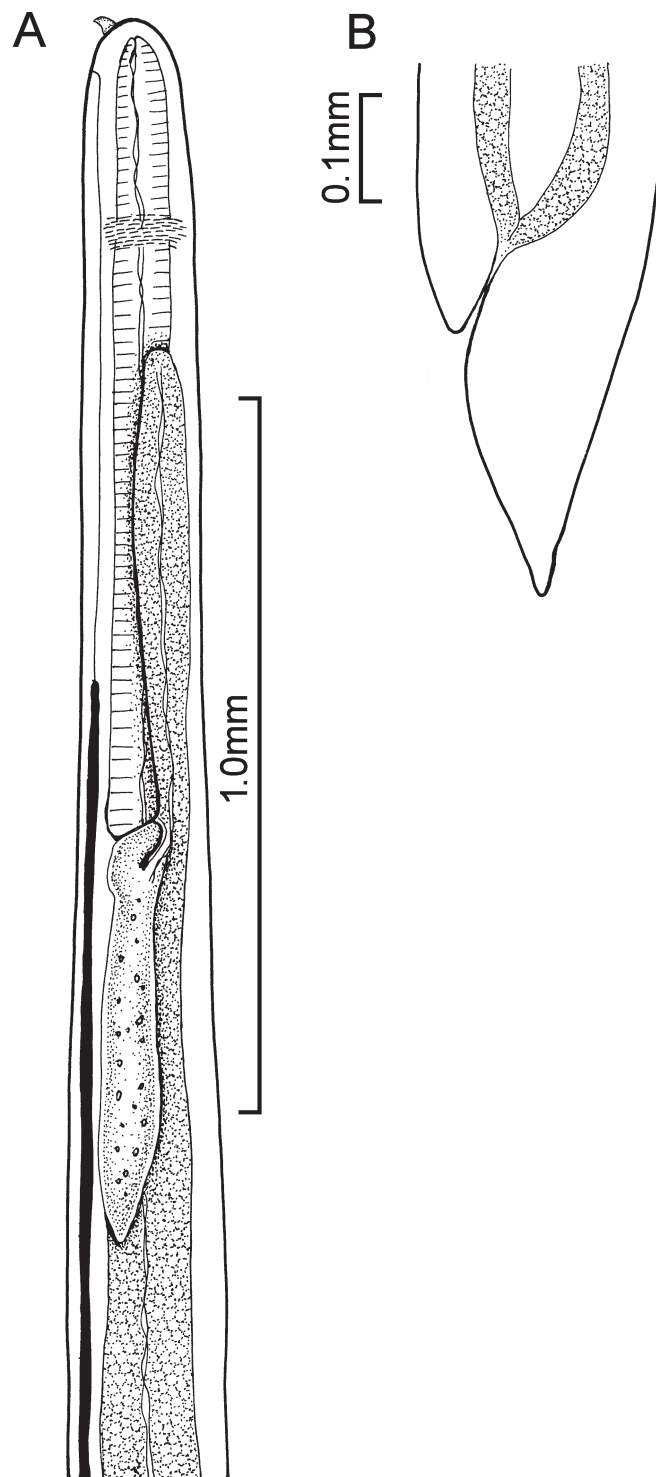


FIGURE 75. **Contracaecum osculatum* (Rudolphi, 1802) Baylis, 1920 (*sensu lato*). A. L3, anterior end, lateral view; B. L3, tail, lateral view. (Redrawn from J. W. Smith & Wootten 1984c)

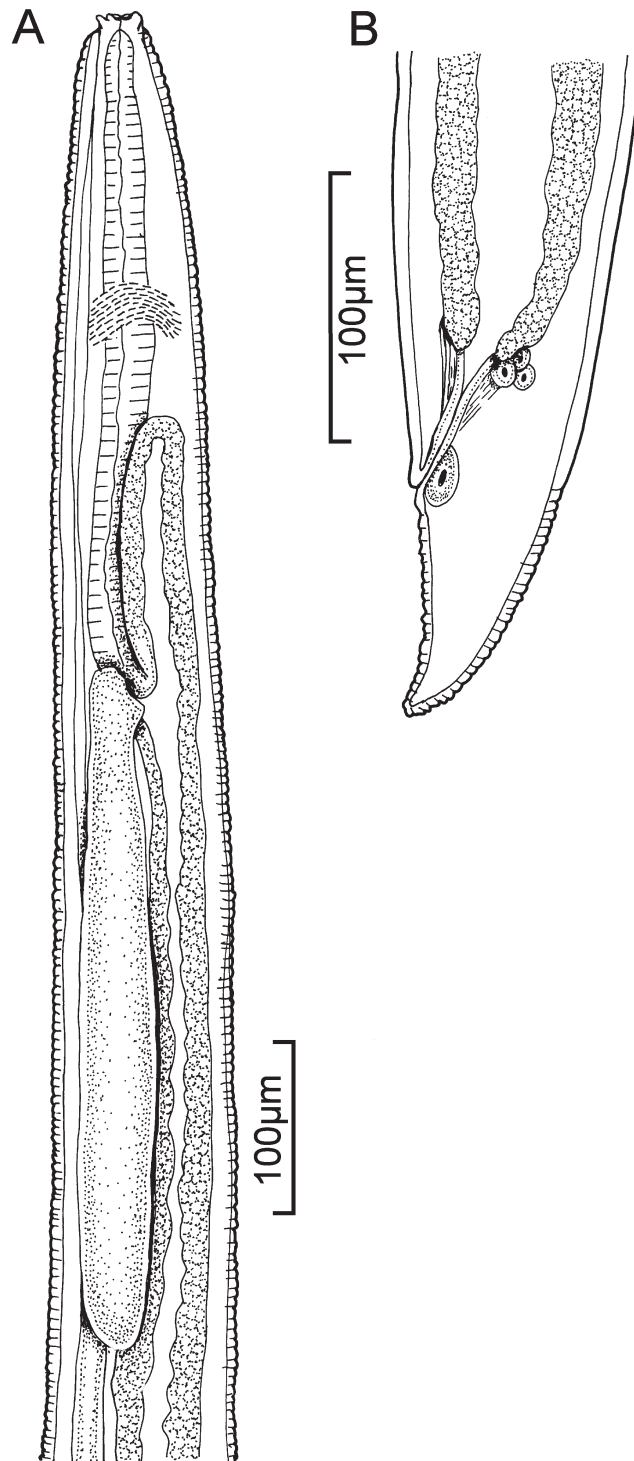


FIGURE 76. **Contracaecum rudolphii* Hartwich, 1964. A. L3, anterior end, lateral view; B. L3, posterior end, lateral view. (Redrawn from Bartlett 1996)

****Contracaecum rudolphii* Hartwich, 1964**

Synonym: *Contracaecum spiculigerum* auct. nec Rudolphi, 1809

Description (after Bartlett 1996, and Moravec 2013). Ten 87-day-old L3 from experimentally infected guppies *Poecilia reticulata* were 0.8–2.9 long, and 0.030–0.090 maximum width. Five 152-day-old L3 were 3.1–3.9 (mean 3.5) long, and 0.110–0.120 (0.114) maximum width. Older larvae were 15.0–24.0 long, and 0.9–2.1 wide. Mouth,

lips, boring tooth, and excretory pore similar to those of *Anisakis simplex* L3 (see Fig. 76A,B,C). Nerve ring 0.150–0.200 (0.167) from anterior end. Length of preventriculus 0.370–0.415 (0.391), ventriculus 0.025–0.030 (0.029), ventricular appendix 0.320–0.380 (0.359), intestinal caecum 0.170–0.225 (0.191) [Fig. 76A], and tail 0.085–0.090 (0.088) [Fig. 76B].

Sites: body cavity, intestinal lumen, musculature

Hosts: *Fundulus heteroclitus*; *Poecilia reticulata* (EX)

Distribution: Nova Scotia

Record: Bartlett 1996

****Contracaecum spiculigerum* (Rudolphi, 1809) Railliet & Henry, 1912**

Description (after Huizinga 1966). Huizinga's tabulated data indicate that seventeen 18-day-old L3 from experimentally infected mummichog *Fundulus heteroclitus* were 0.202–1.902 (mean 1.263) long, and 0.016–0.071 (0.041) wide at ventriculus; however, the mean length is given as 1.236 in the text. [Older larvae are presumably longer and wider (see *C. rudolphii* above).] Nerve ring 0.059–0.128 (0.105) from anterior end. Length of preventriculus 0.109–0.257 (0.197), ventriculus 0.007–0.037 (0.019), ventricular appendix 0.016–0.287 (0.179), intestinal caecum 0.029–0.095 (0.066) [Fig. 77A], and tail 0.031–0.099 (0.061) [Fig. 77B].

Sites: liver, mesenteries

Hosts: *Morone americana* (4); *Oncorhynchus nerka* (1); *Perca flavescens* (2, 3, 5, 6); *Ptychocheilus oregonensis* (1)

Distribution: Alberta, British Columbia, Ontario

Records: 1. Bangham & Adams 1954 (BC); 2. Tedla 1969 (ON); 3. Tedla & Fernando 1969a (ON); 4. Tedla & Fernando 1969b (ON); 5. Tedla & Fernando 1972 (ON); 6. Zelmer 1994 (AB)

****Contracaecum* sp.**

Comments: larvae from fresh-water fishes probably represent either **C. rudolphii* or **C. spiculigerum*, whilst those from marine fishes probably represent **C. osculatum*, or **Contracaecum* and/or **Phocascaris*.

Sites: alimentary tract, body cavity, mesenteries, musculature

Hosts: *Ambloplites rupestris* (4, 52); *Amblyraja radiata* (24); *Ameiurus nebulosus* (30); *Ammodytes hexapterus* (8, 17); *Anguilla rostrata* (26); *Anoplarchus purpureus* (21); *Apeltes quadracus* (59); *Artedius harringtoni* (17, 21); *Aulorhynchus flavidus* (17); *Blepsias cirrhosus* (17); *Catostomus commersoni* (28, 30, 31, 61, 63); *Chitonotus pugetensis* (21); *Chrosomus eos* (63); *Citharichthys stigmaeus* (2); *Clupea pallasii* (2, 8, 17, 21, 38, 40, 41); *Coregonus clupeaformis* (46, 48); *Coryphaenoides rupestris* (53); *Cottus bairdii* (30); *Culaea inconstans* (54, 55); *Cymatogaster aggregata* (21); *Eopsetta jordani* (7); *Esox lucius* (61); *Etheostoma microperca* (31); *Etheostoma nigrum* (30); *Gadus morhua* (1, 44, 67); *Gasterosteus aculeatus* (17, 25, 59); *Glyptocephalus cynoglossus* (14); *Hexagrammos lagocephalus* (17, 21); *Hippoglossoides elassodon* (7); *Hippoglossoides platessoides* (14); *Hippoglossus hippoglossus* (39); *Hippoglossus stenolepis* (62, 65, 66); *Hydrolagus coliei* (2); *Hypomesus pretiosus* (8); *Icelinus filamentosus* (17, 21); *Jordania zonope* (21); *Lepomis gibbosus* (30); *Leptocottus armatus* (17, 21); *Limanda ferrugineus* (14); *Luxilus cornutus* (31); *Lycodes corteziensis* (17, 21); *Lyopsetta exilis* (7); *Malacocottus kincaidii* (21); *Mallotus villosus* (5, 20, 29, 34); *Melanogrammus aeglefinus* (3); *Merluccius productus* (2); *Micropterus dolomieu* (30, 52, 61); *Micropterus salmoides* (56); *Moxostoma anisurum* (61); *Myoxocephalus octodecemspinosus* (57); *Myoxocephalus polyacanthocephalus* (17, 21); *Notropis atherinoides* (61); *Notropis hudsonius* (30, 61); *Oligocottus maculosus* (17, 21); *Oncorhynchus clarkii* (9); *Oncorhynchus gorboscha* (10, 11, 16, 21); *Oncorhynchus keta* (17, 19, 21); *Oncorhynchus kisutch* (17, 19, 21); *Oncorhynchus mykiss* (55); *Oncorhynchus nerka* (10, 11, 13, 17, 21); *Oncorhynchus tshawytscha* (17, 19, 21); *Ophiodon elongatus* (2, 17); *Parophrys vetulus* (7); *Perca flavescens* (6, 30, 58, 61); *Percina caprodes* (30); *Pholis laeta* (21); *Pholis ornata* (17); *Pimephales promelas* (48, 54, 55); *Platichthys stellatus* (17, 21); *Pleuronectes putnami* (14); *Podothecus accipenserinus* (17); *Pseudopleuronectes americanus* (1, 14); *Pungitius pungitius* (54, 55, 59); *Reinhardtius hippoglossoides* (39, 64); *Rhinichthys atratulus* (31); *Rhinogobiopsis nicholsii* (21); *Salmo salar* (18, 23, 42); *Salvelinus alpinus* (32, 43, 51); *Salvelinus fontinalis* (32, 63); *Salvelinus malma* (9, 17, 21); *Sander vitreus* (6); *Scomber* sp. (2); *Scophthalmus aquosus* (14); *Sebastes aleutianus* (37); *Sebastes alutus* (33, 37); *Sebastes*

babcocki (37); *Sebastes borealis* (37); *Sebastes brevispinis* (37); *Sebastes caurinus* (21, 37); *Sebastes ciliatus* (37); *Sebastes crameri* (37); *Sebastes diploproa* (37); *Sebastes elongatus* (37); *Sebastes entomelas* (37); *Sebastes fasciatus* (50); *Sebastes flavidus* (37, 60); *Sebastes goodei* (37); *Sebastes helvomaculatus* (37); *Sebastes maliger* (37); *Sebastes mentella* (12, 50); *Sebastes nebulosus* (37); *Sebastes nigrocinctus* (37); *Sebastes norvegicus* (12, 50); *Sebastes paucispinis* (37); *Sebastes pinniger* (37); *Sebastes polyspinis* (37); *Sebastes proriger* (37); *Sebastes reedi* (37); *Sebastes ruberrimus* (37); *Sebastes variegatus* (37); *Sebastes wilsoni* (37); *Sebastes zacentrus* (37); *Sebastes* sp. (2); *Squalus acanthias* (2, 24); *Synaphobranchus kaupii* (53); *Syngnathus leptorhynchus* (17, 21); *Tautogolabrus adspersus* (27); *Thaleichthys pacificus* (17, 21); *Theragra chalcogramma* (17, 21, 45, 47, 49); *Triglops pingelii* (17, 21); unspecified “fish” (35); unspecified “herring” (36); *Zoarcetes americanus* (1).

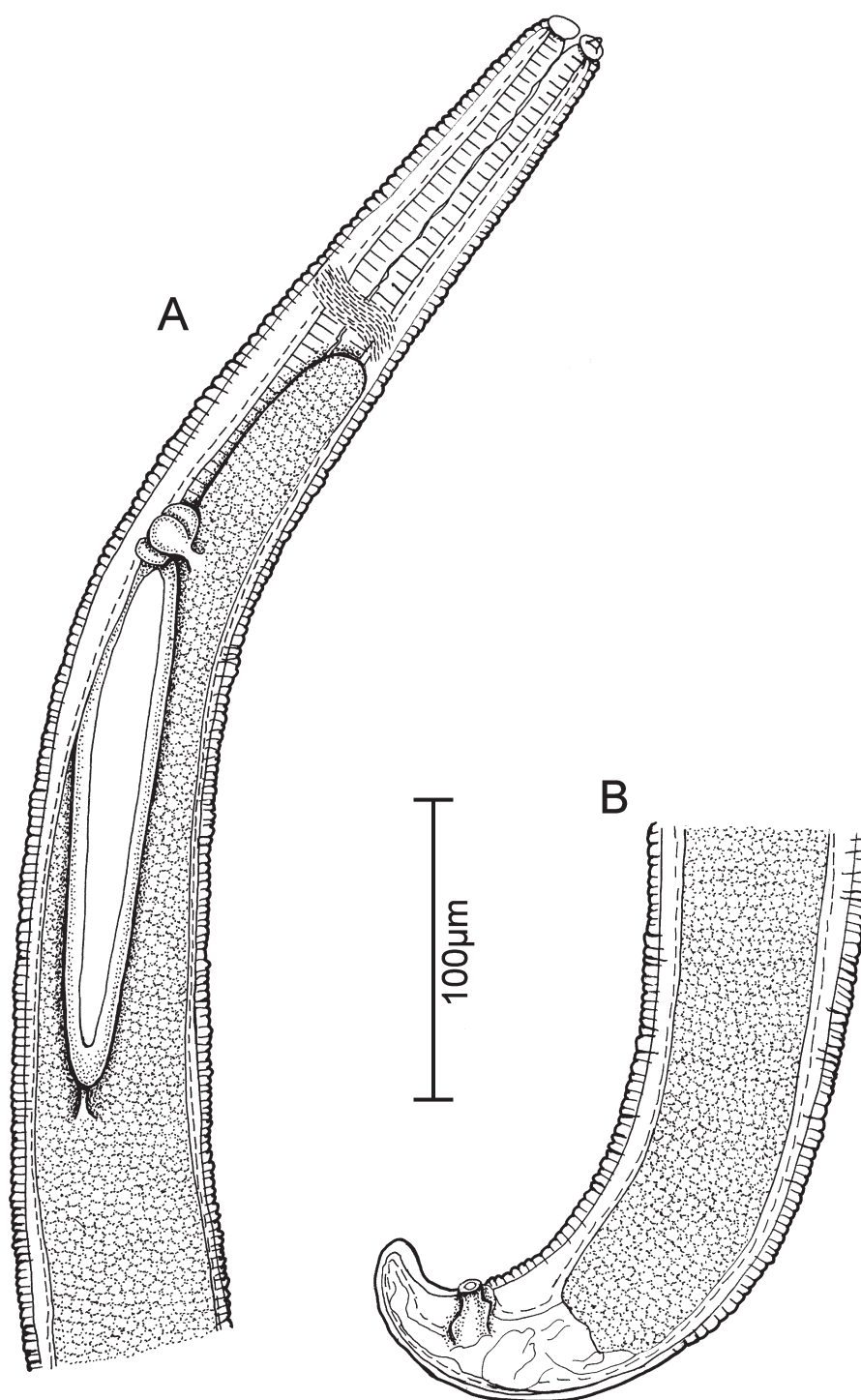


FIGURE 77. **Contracaecum spiculigerum* (Rudolphi, 1809) Railliet & Henry, 1912. A. L3, anterior end, lateral view; B. L3, posterior end, lateral view. (Redrawn from Huizinga 1966).

Distribution: Alberta, Atlantic, British Columbia, Labrador, Manitoba, New Brunswick, Newfoundland, Nova Scotia, Northwest Territories, Ontario, Prince Edward Island, Quebec, Saskatchewan

Records: 1. Clemens & Clemens 1921 (AT); 2. Smedley 1934 (PA); 3. Kuitunen-Ekbaum 1937b (AT); 4. Bangham & Hunter 1939 (ON); 5. Templeman 1948 (AT); 6. Worley & Bangham 1952 (QC); 7. Margolis 1952a (PA); 8. Margolis 1952b (PA); 9. Bangham & Adams 1954 (BC); 10. Margolis 1956 (PA); 11. Margolis 1957 (BC, PAQ); 12. Yanulov 1962 (AT); 13. Margolis 1963 (BC, PA); 14. Ronald 1963 (AT); 15. Wood 1965 (BC); 16. Boyce 1966 (PA); 17. Arai 1967a (PA); 18. Pippy 1967 (PE); 19. Godfrey 1968 (PA); 20. Templeman 1968 (NF); 21. Arai 1969 (PA); 22. Boyce 1969 (PA); 23. Pippy 1969 (AT); 24. Threlfall 1969 (AT); 25. Hanek & Threlfall 1970a (LB, NL); 26. Hanek & Threlfall 1970b (LB, NL); 27. Sekhar S.[sic] & Threlfall 1970 (AT); 28. Threlfall & Hanek 1970a (AT); 29. Winters 1970 (AT); 30. Dechtiar 1972a (ON); 31. Kakonge 1972 (ON); 32. Hicks & Threlfall 1973 (LB); 33. Sekerak & Arai 1973 (PA); 34. Winters & Campbell 1974 (AT); 35. Redkozubova 1976 (AT); 36. Zenkin & Umnova 1976 (AT); 37. Sekerak & Arai 1977 (PA); 38. Arthur 1978 (PA); 39. Redkozubova 1978 (AT); 40. Arthur & Arai 1980a (PA); 41. Arthur & Arai 1980b (PA); 42. Pippy 1980 (AT); 43. Dick & Belosevic 1981 (NT); 44. Appy & Burt 1982 (AT); 45. Arthur *et al.* 1982 (PA); 46. Drouin 1982 (AB); 47. Arthur 1983 (PA); 48. McAllister & Mudry 1983 (AB); 49. Arthur 1984 (PA); 50. Bourgeois & Ni 1984 (AT); 51. Dick 1984 (NT); 52. Anthony 1985 (ON); 53. Houston & Haedrich 1986 (AT); 54. Dick 1987 (MB); 55. Dick *et al.* 1987 (MB); 56. Szalai & Dick 1990 (SK); 57. Khan 1991 (AT); 58. Szalai & Dick 1991 (MB); 59. Marcogliese 1992b (NS); 60. Stanley *et al.* 1992 (PA); 61. Szalai *et al.* 1992a (MB); 62. Blaycock 1996 (PA); 63. Dubois *et al.* 1996 (QC); 64. Boje *et al.* 1997 (AT); 65. Blaycock *et al.* 1998a (PA); 66. Blaycock *et al.* 1998b (PA); 67. Lee & Khan 2000 (AT)

****Contracaecum* sp. and/or **Phocascaris* sp.**

Description: see that for **Contracaecum osculatum* above.

Sites: alimentary tract, body cavity, mesenteries

Hosts: *Cyclopterus lumpus* (7); *Gadus morhua* (2, 3, 4); *Gadus macrocephalus* (7); *Glyptocephalus cynoglossus* (7); *Hippoglossoides platessoides* (2); *Limanda ferrugineus* (7); *Mallotus villosus* (5, 6, 7); *Melanogrammus aeglefinus* (7); *Myoxocephalus octodecemspinosus* (7); *Myoxocephalus scorpius* (7); *Nezumia bairdii* (7); *Pseudopleuronectes americanus* (7); *Raja* spp. (7); *Reinhardtius hippoglossoides* (7); *Theragra chalcogramma* (1); *Urophycis tenuis* (7)

Distribution: Atlantic, Pacific

Records: 1. Berland 1981 (PA); 2. McClelland *et al.* 1983 (AT); 3. McClelland *et al.* 1983b (AT); 4. McClelland *et al.* 1984 (AT); 5. Pálsson & Beverley-Burton 1984 (AT); 6. Pálsson 1986 (AT); 7. Marcogliese 1995a (AT)

****Phocascaris* sp.**

Description: see that for **Contracaecum osculatum* above.

Sites: alimentary tract, musculature, viscera

Hosts: *Gadus morhua* (3, 4, 5); *Hippoglossoides platessoides* (4); *Mallotus villosus* (4); *Myoxocephalus scorpius* (4); *Pseudopleuronectes americanus* (4); *Reinhardtius hippoglossoides* (2); *Tautoglabrus adspersus* (1)

Distribution: Atlantic

Records: 1. Sekhar S. [sic] & Threlfall 1970; 2. Reimer 1981; 3. Marcogliese & Boily 1994; 4. Bratney 1995; 5. Lee & Khan 2000

****Contracaecinea* gen. sp.**

Sites: body cavity, intestinal lumen, mesenteries, musculature, stomach

Hosts: *Gadus morhua* (5); *Fundulus heteroclitus* (6); *Hippoglossoides platessoides* (5); *Mallotus villosus* (4); *Pungitius pungitius* (6); *Reinhardtius platessoides* (1, 2, 3); *Salvelinus alpinus* (8); *Sebastes fasciatus* (7); *Sebastes mentella* (7, 9)

Distribution: Atlantic, Nova Scotia, Quebec

Records: 1. Arthur & Albert 1992b (AT); 2. Arthur & Albert 1993 (AT); 3. Arthur & Albert 1994 (AT); 4. Arthur *et al.* 1995 (AT); 5. Boily & Marcogliese 1995 (AT); 6. Marcogliese 1995b (NS); 7. Moran *et al.* 1996 (AT); 8. Desdevises *et al.* 1998 (QC); 9. Marcogliese *et al.* 2003 (AT)

Subfamily RAPHIDASCARIDINAE Hartwich, 1954

Of the four tribes of this Subfamily recognised by Hartwich (1975) only one, the Raphidascaridinea, represented by two genera, namely, *Hysterothylacium* and *Raphidascaris*, is known from various fish species in Canada.

Key to genera of the Tribe RAPHIDASCARIDINEA Chabaud, 1965

- 1 Intestinal caecum absent; ventricular appendix present; interlabia absent; lips usually not longer than wide; parasitic in teleost fishes *Raphidascaris*
- Intestinal caecum present; ventricular appendix present; interlabia present; lips large, with anterior region forming distally broadened process internally supported by pair of longitudinal thickenings; parasitic in teleost fishes *Hysterothylacium*

Hysterothylacium Ward and Magath, 1917

Synonyms: *Thynnascaris* Dollfus, 1933; *Contracaecum* (*Thynnascaris*) Dollfus 1935; *Contracaecum* (*Erschovicaecum*) Mozgovoi, 1951; *Contracaecum* (*Simplexonema*) Kreis, 1952 *nom. nud.*; *Iheringascaris* Pereira, 1935; *Contracaecum* (*Acollaris*) Araujo, 1970

Generic diagnosis (after Deardorff & Overstreet 1981). Raphidascaridinae. Body elongate, reaching greatest width near midbody. Cuticle with annulations moderately or weakly defined or lacking (presumably unreported). Cuticular alae distinct or indistinct. Lips approximately equal in size, usually wider than long, bearing transparent cuticular flanges on lateral margins; flanges with or without indentations; internal pulp usually pedunculated; dorsal lip with two lateral doubled papillae; subventral lips with amphid, adjacent mediolateral doubled papilla, and single lateral papilla. Dentigerous ridges absent. Interlabia present. Interlabial grooves present or absent. Ventriculus almost spherical; ventricular appendix sac-like or cylindrical, with septum dividing structure into two equal longitudinal pouches; intestinal caecum usually shorter than ventricular appendix. Excretory system with excretory pore at or near nerve ring level, with duct extending to at least left lateral cord. Rectal glands present or absent (presumably unreported). Spicules similar, alate, equal or slightly unequal in length. Gubernaculum absent. Vulva anterior to midbody. Uterus didelphic, opisthodelphic. Tail conical, tip with or without spines. Medioventral pre-cloacal organ usually distinct on pre-cloacal fold. Phasmids usually distinct. Parasites of marine, estuarine and fresh-water fishes.

Comments: Gopar-Merino *et al.* (2005) claimed that 61 species of *Hysterothylacium* have been recognized; however, there are more than 61 species if “morphospecies”, “sibling species” and “cryptic species” are taken into account. According to Rye & Baker (1992) most *Hysterothylacium* species occur in the alimentary tract of marine fishes rather than fresh-water ones. In common with some other aquatic ascaridoids, species of *Hysterothylacium* have evolved remarkable flexibility in completing the life-cycle. For example, Luque *et al.* (2007) reported L4 of *Hysterothylacium* sp. in the haemocoel of amphipods, *Paracorophium excavatum*, from New Zealand waters. Furthermore, several of the adult males showed precocious sexual development, having undergone the 3rd and 4th (final) moults in the amphipod host. Moreover, *H. haze* also departs from the life-cycle known for many other species. Yoshinaga *et al.* (1989) studied natural and experimental infections of *H. haze* in gobies *Acanthogobius flavimanus* from Tokyo Bay, concluding that the life-cycle may be direct and involve invertebrates as paratenic hosts; this life-cycle might represent an example of extreme precocity in which the fish intermediate host has also become a final host (Anderson 1998).

Like *Contracaecum* and *Phocascaris* (see above) the genus *Hysterothylacium* is defined by characteristics of the adults, and agreeing again with Moravec (2013) it is difficult to assign larvae to any one species. It is not

possible to design a key for their reliable identification, and the following keys are for the identification of the adults only. Feeding experiments to rear larvae to adults and the application of molecular markers to identify species may be solutions to this and similar problems. Several taxa are considered and, where possible, described, their names having appeared in the relevant Canadian literature. Only two *Hysterothylacium* species (***H. analarum* and ***H. brachyurum*) are known from Canadian fresh-water fishes. While four species (***H. aduncum*, *H. corrugatum*, *H. incurvum* and *H. reliquens*) have been reported from Canadian marine fishes, only ***H. aduncum* is abundant, having been recorded from a wide variety of fish species. In contrast, there is only one report, that of Hogans *et al.* (1983), for each of the other three *Hysterothylacium* species. All of the specimens were recovered from the stomachs of swordfish, *Xiphias gladius*, collected from the “northwest Atlantic Ocean”. The coordinates for the collection site(s) are not given but it may be assumed that these were within Canadian waters, so the descriptions are given below. Swordfish are oceanic travellers that enter Canadian waters usually about June and leave in October and November. They move through a great range of depths, feeding on various fish species and shortfin squid, *Illex illecebrosus* (Scott and Scott 1988). It is possible, therefore, that infections with the three species of *Hysterothylacium* were acquired by swordfish at locations remote from Canadian waters. It is worth noting that Hogans *et al.* (1983) deposited representative specimens of each nematode species (and of the other helminths collected) at a public museum and provided catalogue numbers; details may be found in the original paper. While two other species of *Hysterothylacium*, *H. magnum* and *H. melanogrammi*, have been recorded from Canadian marine fishes the species are of doubtful validity, as discussed below.

Key to species of *Hysterothylacium* from Canadian fresh-water fishes

- 1 Broad lateral alae present; tail tip with few sharply pointed spines***H. brachyurum*
- Lateral alae absent; tail tip with numerous blunt spines***H. analarum*

***Hysterothylacium analarum* Rye & Baker, 1984

Description (after Rye & Baker 1984, 1992). With characteristics of the genus. Body cuticle with narrow transverse striations and wide, irregularly spaced transverse folds. Lateral alae absent. Narrow caudal alae present. Cephalic lips equal in length and width. Dorsal lip with two double papillae, subventral lips each with one double papilla, one single papilla and one amphid. Interlabia prominent (Fig. 78A). Intestinal caecum and ventricular appendix present. Excretory pore at level of nerve ring (Fig. 78B). Tail tip of both sexes covered with numerous blunt spines (Fig. 78D).

Males: 18.1 (13.5–19.1) long. Intestinal caecum 1.19 (0.54–2.30) and ventricular appendix 0.300 (0.225–0.325) long. Excretory pore 0.390 (0.325–0.475) and nerve ring 0.390 (0.325–0.440) from anterior end (Fig. 78B). Tail conical 0.240 (0.160–0.190) long. Posterior half of tail with four pairs of papillae: two pairs lateral and two pairs subventral (one or more may be missing). Anterior half of tail with three pairs of subventral papillae. Anterior lip of anus with one unpaired papilla. Pre-cloacal region with 18 (13 to 21) pairs of subventral caudal papillae extending anteriorly. Pre-cloacal subventral region with numerous caudal muscles. Spicules equal, 0.580 (0.450–0.625) long, alate, rounded distally, with blunt capitulum (Fig. 78C). Gubernaculum absent.

Females: 22.05 (19.82–25.55) long. Preventriculus 2.1 (2.45–3.87) long. Intestinal caecum 1.11 (1.55–1.93) and ventricular appendix 0.375 (0.350–0.480) long. Excretory pore 0.390 (0.345–0.410), nerve ring 0.390 (0.345–0.460) and vulva 7.10 (6.96–8.80) from anterior end. Eggs oval, 0.080 in diameter, thin walled, embryos at 1- or 2-cell stage. Tail conical, 0.370 (0.380–0.440) long. One pair post-cloacal lateral papillae present.

L4: 3.367–5.863 long (male); 3.582–5.755 (female). Mouth opening triangular. Lips well developed. Dorsal lip with two double papillae, subventral lips each with one double papilla, one single papilla, and an amphid. Each lip with two single inner papillae. Interlabia triangular, apically pointed, height about one-third at base, similar to those of adult. Narrow lateral alae extending length of body. Vulva at middle of body, nonpatent. Posterior end of tail with numerous blunt projections.

L3: 1.355–4.172 long. Lips absent. Mouth opening triangular, boring tooth absent. Two subdorsal and two subventral double papillae and two single sublateral papillae present. Lateral alae extend length of body. Genital primordium in early 3rd stage similar to that of 2nd-stage larvae. In late 3rd-stage larvae genital primordium Y-shaped

with undifferentiated vagina in females and an elongate column of cells in males. Tail conical with six to eight blunt projections.

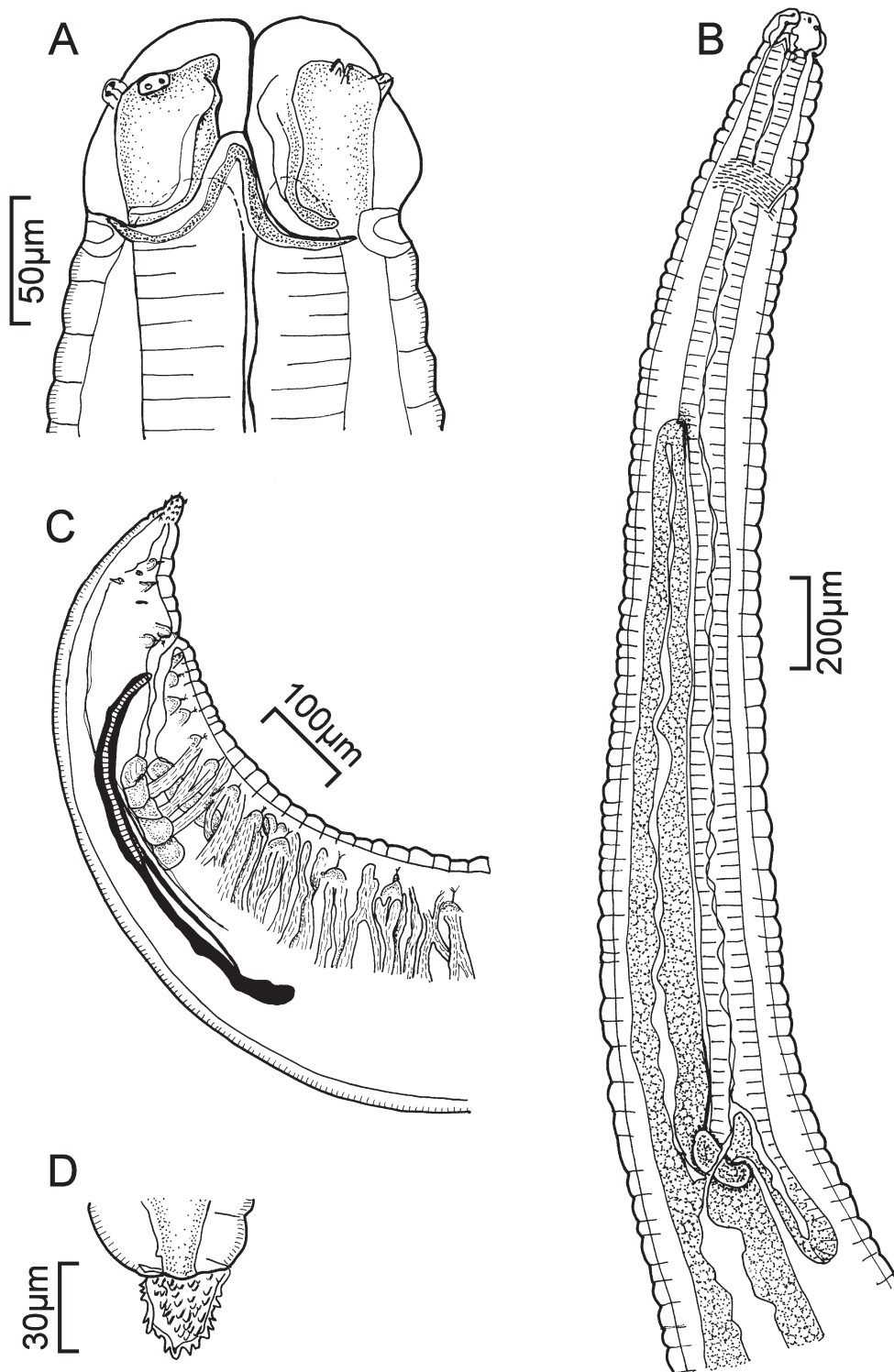


FIGURE 78. ***Hysterothylacium analarum* Rye & Baker, 1984. A. head, dorso-lateral view; B. anterior end, lateral view; C. male, posterior end, lateral view, D. male, tail tip, lateral view. (Redrawn from Rye & Baker 1984)

L2: 0.190–0.249 long (freshly hatched); 0.312–0.587 (recovered from various sites in fishes). Mouth opening triangular, lips absent. Head end with large ventral boring tooth. Two subdorsal and two subventral cephalic papillae present. Lateral alae extend length of body. Genital primordium oval, comprising four to eight cells. Tail conical with six to eight spiny protuberances.

Sites: intestinal lumen, mesenteries, serosal nodules
 Host: *Lepomis gibbosus*
 Distribution: Ontario
 Records: Rye & Baker 1984; Rye & Baker 1987; Rye & Baker 1992

*****Hysterothylacium brachyurum* Ward & Magath, 1917**

Synonyms: *Contracaecum brachyurum* (Ward & Magath, 1917) Van Cleave & Mueller, 1934; *Thynnascaris brachyura* (Ward & Magath, 1917) Margolis & Arthur, 1979

Description (after Van Cleave & Mueller 1934, and Rye & Baker 1984). With characteristics of the genus. Lips large and prominent with well developed interlabia. Lateral alae arise from the interlabia between the subventral and dorsal lips and extend posteriorly to about the level of the posterior end of the preventriculus. A pair of minute, blind-ending deirids are located within the alae at nerve ring level. Nerve ring about 0.5 behind anterior end (Fig. 79A). Preventriculus 6.0–7.0 long, with “a clearly defined ventriculus”. Intestinal caecum 5.6 long, ventricular appendix relatively short, about 1.0 long. Tail tip of both sexes with few relatively large spines, sharply pointed (Fig. 79B).

Males: about 60 long and 0.9 wide. Spicules equal, about 0.84 long. Arrangement of male caudal papillae not clear.

Females: about 80 to 90 long and 1.0 wide. Vulva “some distance” anterior to middle of body. Eggs *in utero* 0.060 x 0.050.

Comments: *Hysterothylacium brachyurum* should be redescribed, especially as it is the type species of the genus. Moreover, an account of the life-history of *H. brachyurum*—like that provided by Rye & Baker (1992) for *H. analarum*—does not appear to be available. In view of the possibility that larvae of *H. brachyurum* occur in the organs and tissues of Canadian fishes the taxon is adorned with a double asterisk. *H. brachyurum* has been reported frequently from a variety of fresh-water hosts throughout North America but, as Rye & Baker (1984) pointed out, in most surveys no voucher specimens were deposited in permanent collections so identifications cannot be confirmed; there is evidence that *H. brachyurum* has been confused in the past with *H. analarum* and *Raphidascaris acus* (Rye & Baker 1984).

Sites: intestinal lumen, liver, mesenteries, pyloric caeca

Hosts: *Ambloplites rupestris* (4, 7, 8, 18, 19); *Anguilla rostrata* (3); *Coregonus artedii* (10, 14); *Culaea inconstans* (22); *Esox lucius* (4, 5, 7, 8, 10, 15, 16, 18, 19, 20, 21); *Esox masquinongy* (4, 7, 8, 18); *Etheostoma exile* (4, 7); *Lepomis gibbosus* (2, 18); *Lota lota* (3, 6, 8, 9, 11, 17, 19, 21); *Micropterus dolomieu* (2, 4, 7, 18, 20, 21); *Micropterus salmoides* (1, 2, 4, 7); *Moxostoma anisurum* (8); *Notemigonus crysoleucas* (4, 7); *Notropis atherinoides* (4, 8); *Noturus flavus* (21); *Perca flavescens* (12, 18, 19, 20, 22); *Percopsis omiscomaycus* (4, 7, 8, 21); *Salvelinus fontinalis* (3, 19, 22); *Salvelinus fontinalis* x *Salvelinus namaycush* (9, 13, 21, 22); *Salvelinus malma* (9, 11, 17); *Salvelinus namaycush* (9); *Sander canadensis* (8); *Sander vitreus* (4, 7, 8, 12, 18, 21)

Distribution: Alberta, British Columbia, Manitoba, Ontario, Quebec

Records: Bangham & Hunter 1939 (ON); 2. Bangham 1941 (ON); 3. Bangham & Venard 1946 (ON); 4. Bangham 1951 (ON); 5. Worley & Bangham 1952 (QC); 6. Bangham & Adams 1954 (BC); 7. Bangham 1955 (ON); 8. Dechtiar 1972a (ON); 9. Mudry & Anderson 1977 (AB); 10. Watson 1977 (MB); 11. Anon. 1978 (BC); 12. Anthony 1978b (ON); 13. Dechtiar & Berst 1978 (ON); 14. Watson & Dick 1979 (MB); 15. Watson & Dick 1980 (MB); 16. Anthony 1983 (ON); 17. Arai & Mudry 1983 (BC); 18. Dechtiar & Christie 1988 (ON); 19. Dechtiar & Lawrie 1988 (ON); 20. Dechtiar & Nepszy 1988 (ON); 21. Dechtiar *et al.* 1988 (ON); 22. Dechtiar *et al.* 1989 (ON)

Key to species of *Hysterothylacium* from marine fishes

- | | | |
|---|--|--------------------|
| 1 | Deep interlabial grooves present; spicules 2.6–8.7 long, ratio 1: 0.9–1.0; cuticle with enlarged and modified annules on ventral surface of males near cloaca; tail tip usually lacking spines | <i>H. incurvum</i> |
| - | Interlabial grooves absent | 2 |

- 2 Tail tip lacking spines; spicules 1.2–2.6 long, ratio about equal *H. corrugatum*
- Tail tip with spines 3
- 3 Tail tip multispinous; spicules 1.7–2.4 long, ratio variable. *H. reliquens*
- Tail tip with few spines; spicules 2.0–4.65, ratio equal *H. aduncum*

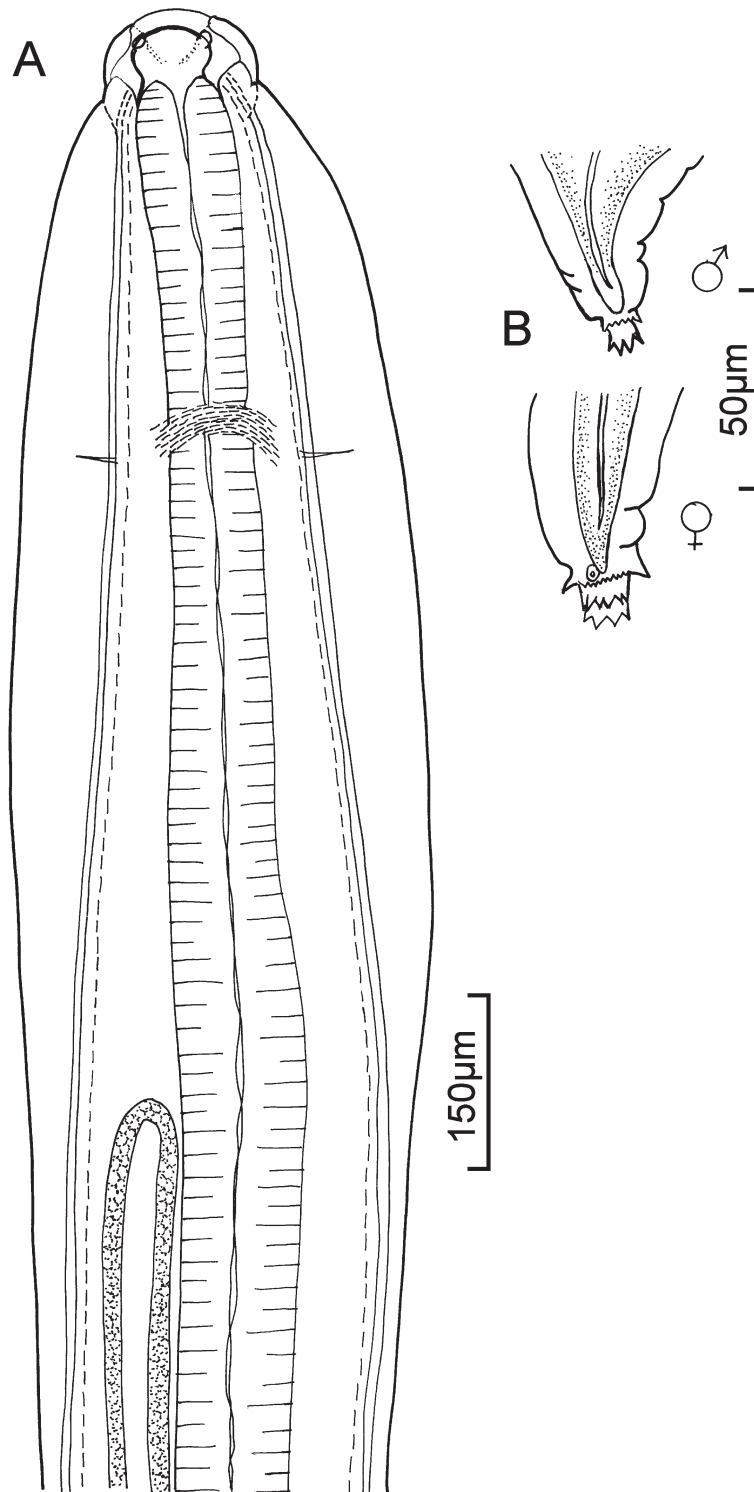


FIGURE 79. ***Hysterothylacium brachyurum* Ward & Magath, 1917. A. male, anterior end, dorso-ventral view; B. male and female tail tips. (Redrawn from Rye & Baker 1984)

*****Hysterothylacium aduncum* (Rudolphi, 1802) Deardorff & Overstreet, 1981**

Synonyms: *Thynnascaris adunca* (Rudolphi, 1802) Hartwich, 1957; *Contracaecum aduncum* (Rudolphi, 1802) Baylis, 1920; *Contracaecum gadi* (O. F. Müller, 1777) Johnston & Mawson, 1945; *Contracaecum clavatum* (Rudolphi, 1809) Baylis, 1920

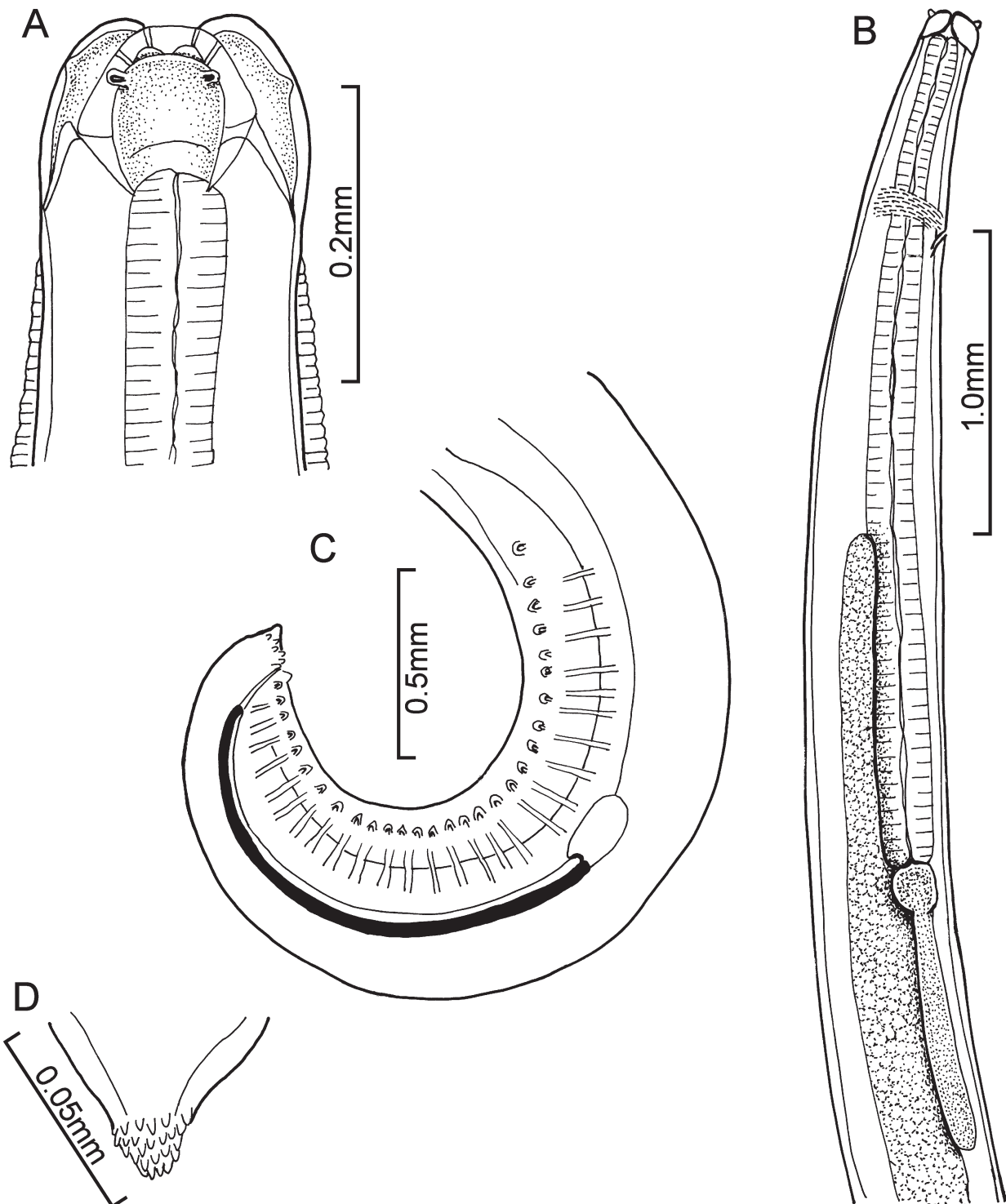


FIGURE 80. *****Hysterothylacium aduncum* (Rudolphi, 1802) Deardorff & Overstreet, 1981.** A. male, head; B. female, anterior end; C. male, posterior end; D. male, tail tip showing spiny process. (Redrawn from Moravec 2013)

Description (after Moravec 2013). With characteristics of the genus. Females larger than males. Lips of approximately equal size, with wide membranous flanges broadest near their base; dorsal lip with two subdorsal papillae; each subventral lip with one double subventral papilla and small simple papilla and amphid situated laterally; pulp of lips with at either side small rounded lobe at its anterior margin. Interlabia triangular, broad, with distinct cuticular margin. Interlabial grooves absent. Cervical alae starting short distance below level of base of subventral lips, gradually becoming wider (maximum width 0.04–0.05) and extending posteriorly to posterior limit of preventriculus. Preventriculus narrow, small ventriculus globular; ventricular appendix narrow, about as long as intestinal caecum; intestinal caecum represents about 30–40% of preventricular length. Nerve ring encircling preventriculus at border of first and second fifths of its length; excretory pore just below nerve ring level. Intestine dark, straight. Rectum short, hyaline, surrounded by three unicellular rectal glands. Tail of both sexes conical, ending in small process covered with fine spines.

Males: 18.0–35.0 long, maximum width 0.430–0.800. Dorsal lip 0.151–0.153 long, 0.144 wide; ventro-lateral lips 0.138–0.150 long, 0.131–0.138 wide (Fig. 80A). Preventriculus 1.94–3.23 long, ventriculus 0.154–0.170 x 0.124–0.144, ventricular appendix 0.54–0.64 long, and intestinal caecum 0.65–0.93 long. Nerve ring and deirids 0.530–0.540 and 0.590–0.600 from anterior end. Tail conical, 0.108–0.139 long, ending in small process covered with fine spines (Fig. 80D). Twenty three pairs pre-cloacal papillae, two pairs ad-cloacal papillae, and four to five pairs post-cloacal papillae—last pair lateral, remaining pairs subventral. Anterior cloacal lip with one unpaired papilla. Spicules equal, 2.00–4.65 long, with narrow membranous wings; distal tip of spicules rounded (Fig. 80C).

Females: 24.0–48.0 long, maximum width 0.72–1.40. Dorsal lip 0.143–0.155 long, 0.149–0.181 wide; ventro-lateral lips 0.153 long, 0.159–0.163 wide. Preventriculus 2.25–4.12 long, ventriculus 0.171–0.180 x 0.155–0.165, ventricular appendix 0.62–0.69 long, and intestinal caecum 0.91–1.08 long. Nerve ring and deirids 0.66–0.90 and 1.08 from anterior end (Fig. 80B). Tail conical 0.270–0.420 long, ending in small process covered with fine spines. Vulva at end of first third of body length, 9.0–16.5 from anterior end. Vagina narrow, long, directed posteriorly and dividing into two posteriorly directed uterine branches filled with eggs; ovaries situated in posterior part of body. Eggs almost spherical, 0.062–0.070 x 0.046–0.047.

L4: 12.0–31.0 long, maximum width 0.22–0.47. Mouth surrounded by three lips comparatively narrow, lacking the large flanges of adults. Preventriculus 1.85–3.85 long, ventricular appendix 0.61–0.98, intestinal caecum 0.65–1.23. Nerve ring and excretory pore 0.34–0.61 and 0.42–0.66 from anterior end. Tail conical, 0.11–0.29 long, tail tip covered with numerous minute projections.

L3: 6.6–21.6 long, maximum width 0.16–0.33. Mouth opening usually T-shaped, two basal projections of ventral boring tooth extending along its margin. No distinct lips present. Two subventral and two subdorsal papillae at anterior end as well as one dorsal antero-median papilla. Cuticle transversely striated. Preventriculus 1.00–2.00 long, ventriculus small. Ventricular appendix 0.40–0.68 long, intestinal caecum 0.33–0.92 long. Nerve ring and excretory pore 0.28–0.45 and 0.31–0.50 from anterior end. Tail conical, 0.12–0.21 long, with pointed tip.

Comments: *Hysterothylacium aduncum* appears to be the most abundant species of the genus known from marine fishes in Canadian waters. According to Klimpel & Ruckert (2005) it is also the most abundant anisakid nematode of North Sea fishes. *Hysterothylacium aduncum* may be carried into Canadian fresh waters by anadromous or catadromous fishes but is not able to reproduce there.

Sites: alimentary tract, body cavity, intestinal lumen, mesenteries, musculature, stomach, stomach wall, viscera

Hosts: *Alosa pseudoharengus* (13); *Alosa sapidissima* (28, 58); *Ammodytes dubius* (10); *Anarhichas lupus* (47); *Atheresthes stomias* (36, 66); *Aulorhynchus flavidus* (5); *Clupea harengus* (38, 40, 44); *Clupea pallasii* (16, 17, 18, 19); *Coryphaenoides rupestris* (11, 12, 23, 24, 43); *Cryptacanthodes giganteus* (3); *Eopsetta jordani* (2, 3); *Gadus macrocephalus* (3); *Gadus morhua* (1, 13, 14, 25, 29, 53, 68, 72, 73); *Glyptocephalus cynoglossus* (4, 21, 29); *Glyptocephalus zachirus* (2, 3); *Hippoglossoides elassodon* (2, 3); *Hippoglossoides platessoides* (4, 21, 29, 42, 61); *Hippoglossus hippoglossus* (4, 21); *Hippoglossus stenolepis* (62, 65); *Hypomesus pretiosus* (3); *Limanda ferrugineus* (4, 61); *Macrourus berglax* (23); *Mallotus villosus* (46, 60); *Melanogrammus aeglefinus* (13, 14, 22); *Merluccius albidus* (50); *Merluccius bilinearis* (50); *Merluccius productus* (30); *Microgadus tomcod* (1); *Microstomus pacificus* (36); *Myoxocephalus scorpius* (1); *Nezumia bairdii* (23); *Oncorhynchus gorboscha* (27, 32); *Oncorhynchus keta* (32, 41); *Oncorhynchus kisutch* (3, 32); *Oncorhynchus mykiss* (37); *Oncorhynchus nerka* (3, 32); *Ophiodon elongatus* (3); *Parophrys vetulus* (2, 3, 36); *Phycis chesteri* (50); *Podothecus accipenserinus* (5); *Pseudopleuronectes americanus* (1, 4, 61, 67, 70); *Reinhardtius hippoglossoides* (21, 51, 55, 56, 57, 59, 64); *Rhinochimaera atlantica* (35); *Salmo salar* (1, 6, 7, 9, 20);

Salvelinus alpinus (9, 31, 39, 52); *Salvelinus fontinalis* (45, 48, 49); *Salvelinus namaycush* (9, 31); *Scomber scombrus* (1, 13); *Sebastes aleutianus* (15); *Sebastes alutus* (3, 15); *Sebastes babcocki* (15); *Sebastes brevispinis* (15); *Sebastes caurinus* (15); *Sebastes crameri* (15); *Sebastes diploproa* (15); *Sebastes entomelas* (15); *Sebastes fasciatus* (34, 63); *Sebastes flavidus* (15); *Sebastes helvomaculatus* (15); *Sebastes maliger* (15); *Sebastes mentella* (34, 63, 69); *Sebastes nebulosus* (15, 54); *Sebastes norvegicus* (34); *Sebastes paucispinis* (15); *Sebastes pinniger* (15); *Sebastes polyspinis* (15); *Sebastes proriger* (15); *Sebastes reedi* (15); *Sebastes ruberrimus* (3, 15); *Sebastes variegatus* (15); *Sebastes zacentrus* (15); *Tautoglabrus adspersus* (1); *Theragra chalcogramma* (3, 26, 33, 36); *Urophycis chuss* (50); *Urophycis tenuis* (50, 71); *Xiphias gladius* (28)

Distribution: Atlantic, British Columbia, Labrador, New Brunswick, Newfoundland, Nova Scotia, Northwest Territories, Pacific

Records: 1. Heller 1949 (AT); 2. Margolis 1952a (PA); 3. Margolis 1952b (PA); 4. Ronald 1963 (AT); 5. Arai 1969 (PA); 6. Pippy 1969 (AT, NS); 7. Pippy 1970 (AT); 8. Sekhar S. [sic] & Threlfall 1970 (AT); 9. Hicks & Threlfall 1973 (LB); 10. Scott 1973 (AT); 11. Zubchenko 1975 (AT); 12. Zubchenko 1976 (AT); 13. Gaevskaya & Umnova 1977 (AT); 14. Linkletter *et al.* 1977 (AT); 15. Sekerak & Arai 1977 (PA); 16. Arthur 1978 (PA); 17. Arthur & Arai 1979 (PA); 18. Arthur & Arai 1980a (PA); 19. Arthur & Arai 1980b (PA); 20. Pippy 1980 (AT); 21. Zubchenko 1980 (AT); 22. Scott 1981 (AT); 23. Zubchenko 1981a (AT); 24. Zubchenko 1981b (AT); 25. Appy & Burt 1982 (AT); 26. Arthur *et al.* 1982 (PA); 27. Margolis 1982 (NF); 28. Hogans *et al.* 1983 (AT); 29. McClelland *et al.* 1983a (AT); 30. Sankurathri *et al.* (PA); 31. Stewart & Bernier 1983 (NT); 32. Anon. 1984 (BC); 33. Arthur 1984 (PA); 34. Bourgeois & Ni 1984 (AT); 35. Hogans & Hurlbut (AT); 36. Kabata & Whitaker 1984 (PA); 37. Margolis 1984 (PA); 38. McGladdery 1984 (AT); 39. Stewart & Bernier 1984 (NT); 40. McGladdery & Burt 1985 (AT); 41. Whitaker 1985 (PA); 42. Zubchenko 1985a (AT); 43. Zubchenko 1985b (AT); 44. Chenoweth *et al.* 1986 (AT); 45. Frimeth 1986 (NB); 46. Pálsson 1986 (AT); 47. Bray 1987 (AT); 48. Frimeth 1987a (NB); 49. Frimeth 1987b (NB); 50. Scott 1987 (AT); 51. Wierzbicka 1988 (AT); 52. Bouillon & Dempson 1989 (LB); 53. Bratney *et al.* 1990 (AT); 54. Holmes 1990 (PA); 55. Wierzbicka 1991a (AT); 56. Wierzbicka 1991b (AT); 57. Krzykowski & Wierzbicka 1992 (AT); 58. Hogans *et al.* 1993 (AT); 59. Arthur & Albert 1994 (AT); 60. Arthur *et al.* 1995 (AT); 61. Martell & McClelland 1995 (AT); 62. Blaycock 1996 (PA); 63. Moran *et al.* 1996 (AT); 64. Boje *et al.* 1997 (AT); 65. Blaycock *et al.* 1998a (PA); 66. Wierzbicka & Piasecki 1998 (PA); 67. Khan 1999 (AT); 68. Lee & Khan 2000 (AT); 69. Marcogliese *et al.* 2003 (AT); 70. McClelland *et al.* 2005 (AT); 71. Melendy *et al.* 2005 (AT); 71. Khan *et al.* 2011 (NF); 73. McClelland & Melendy 2011 (AT)

***Hysterothylacium corrugatum* Deardorff & Overstreet, 1981**

Description (after Deardorff & Overstreet 1981). With characteristics of the genus. Body reaching greatest width near midbody. Cuticle with inconspicuous annulations except ventrally on male's posterior. Cervical alae not flaring. Lips about equal in size, occasionally wider than long; flanges widest near base, indented at anterior 2/5. Pulp for each lip not narrowed at base, each with two to four lobular projections often a few times longer than wide. Interlabia with height equal to or slightly less than width at base, with rounded tips. Interlabial grooves absent (Fig. 81A). Preventriculus clavate, 5–13% of body length. Ventriculus narrower than widest level of preventriculus, generally longer than broad; ventricular appendix descending without angulation from posterior portion of ventriculus. Nerve ring located between anterior 6–12% of preventriculus. Excretory pore immediately behind level of nerve ring. Tail gradually tapering, ending without spines.

Males: body 26–50 long by 0.4–1.0 wide. Preventriculus 3.0–5.6, ventriculus 0.036–0.154, ventricular appendix 2.4–3.8, and intestinal caecum 2.3–4.6 long. Spicules similar length: left one 1.2–2.5, right one 1.2–2.6. Caudal papillae 29 to 31 pairs, 24 to 26 pre-cloacal pairs, four post-cloacal pairs, one para-anal pair, doubled. Distinct medioventral pre-cloacal organ, papillated. Modified annules on ventral surface, beginning near anus, extending anteriorly 1.0–4.1. Tail flexed ventrad, lacking spines (Fig. 81B).

Females: body 100–142 long by 1.7–2.6 wide. Preventriculus 5.5–8.5, ventriculus 0.154–0.472, ventricular appendix 3.5–4.3, and intestinal caecum 5.3–7.2 long. Vulva opening 35 to 40 from anterior end. Ovaries rarely extending anteriad beyond level of vulva. Eggs 0.040–0.080 in diameter. Tail tapered, lacking spines.

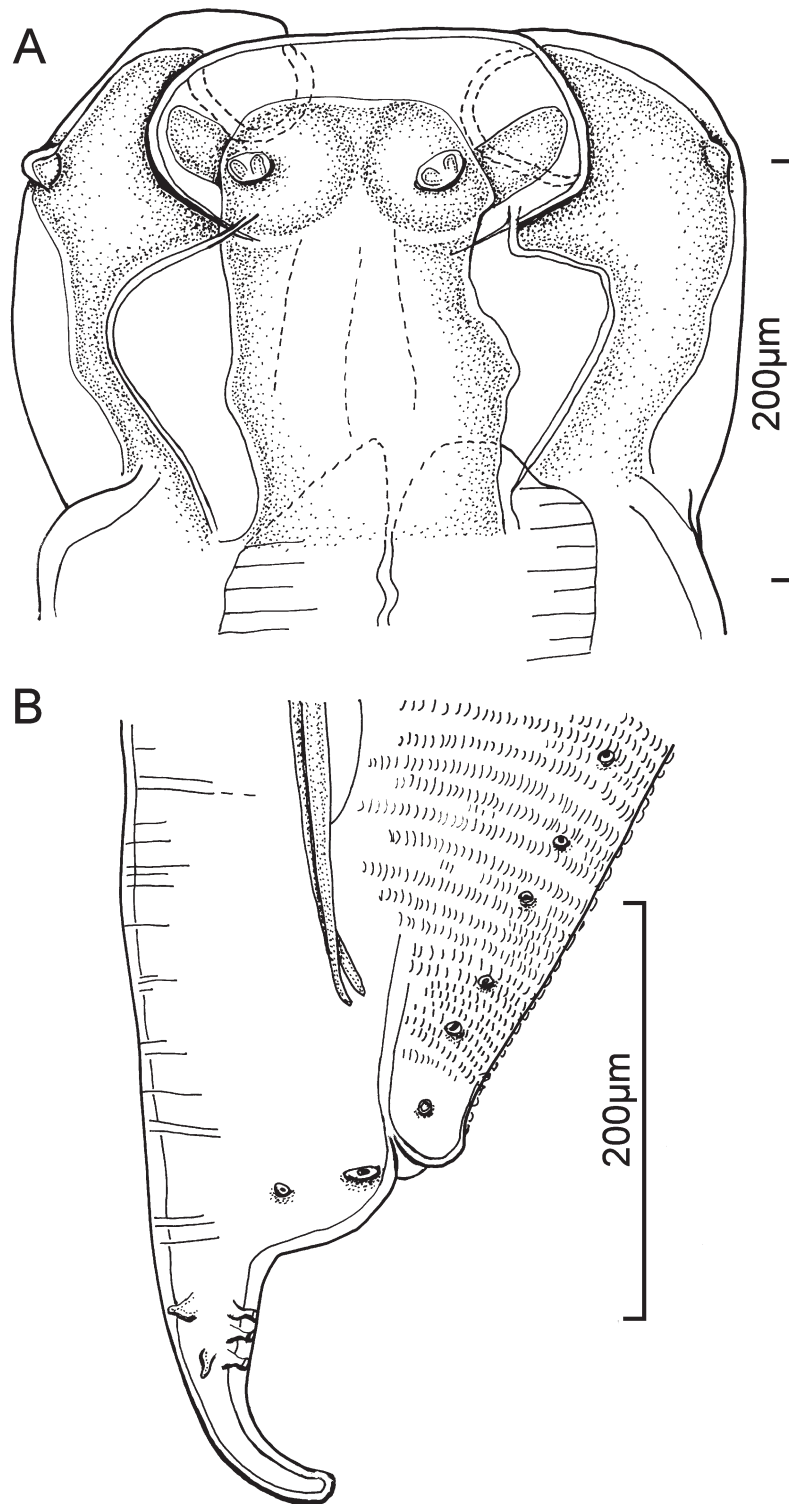


FIGURE 81. *Hysterothylacium corrugatum* Deardorff & Overstreet, 1981. A. head, lips, dorsal view; B. male, posterior end showing post-cloacal and pre-cloacal papillae, and modified annules. (Redrawn from Deardorff & Overstreet 1981)

Site: stomach

Host: *Xiphias gladius*

Distribution: Atlantic

Record: Hogans *et al.* 1983

***Hysterothylacium incurvum* (Rudolphi, 1819) Deardorff & Overstreet, 1981**

Synonyms: *Thynnascaris incurva* (Rudolphi, 1819) Dollfus, 1935; *Contracaecum incurvum* (Rudolphi, 1819) Baylis & Daubney, 1922

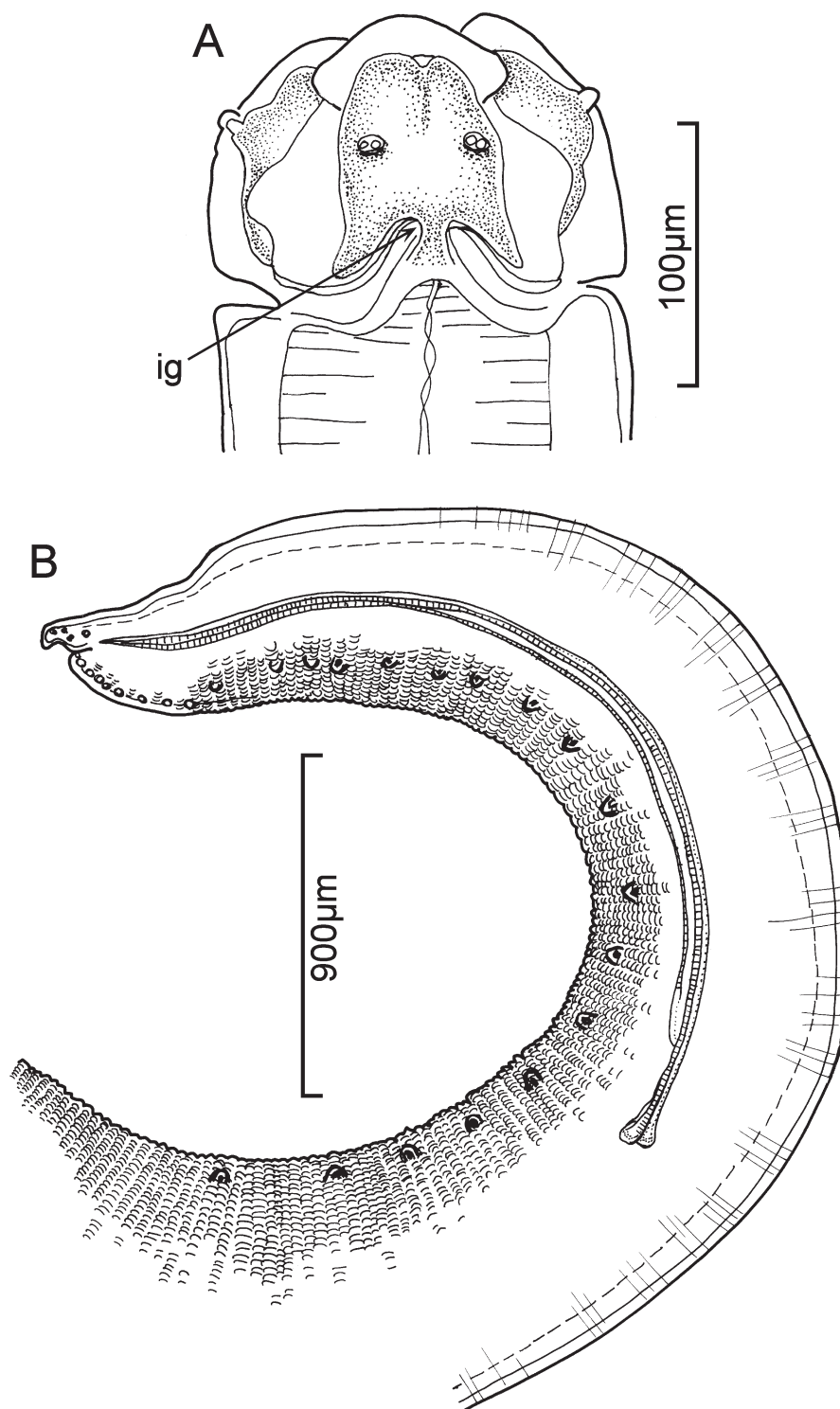


FIGURE 82. *Hysterothylacium incurvum* (Rudolphi, 1809) Deardorff & Overstreet, 1981. A. head, lips, dorsal view, showing interlabial groove (ig); B. male, posterior end, showing caudal papillae and annules on ventral surface, lateral view. (Redrawn from Deardorff & Overstreet 1981)

Description (after Deardorff & Overstreet 1981). With characteristics of the genus. Body reaching greatest width near midbody. Cuticle with inconspicuous annulations except ventrally on male's posterior. Lateral alae bifurcate at their tips throughout worm. Cervical alae not flaring. Lips approximately equal in size, all wider than long; flanges widest near base, indented at anterior 1/3. Pulp conspicuously narrow near base. Interlabia with height two times greater than width at base, with rounded tips. Interlabial grooves deep, adjacent grooves nearly merging at base of each lip (Fig. 82A). Preventriculus clavate, 7–16% of body length. Ventriculus narrower than widest level of preventriculus. Nerve ring located between anterior 7–19% of preventriculus. Excretory pore immediately posterior to nerve ring level. Tail gradually tapering, usually without spines.

Males: body 17–34 long by 0.606–0.772 wide. Preventriculus 2.3–5.2, ventriculus 0.117–0.166, ventricular appendix 1.7–2.6, and intestinal caecum 1.9–4.5 long. Spicules 2.6–8.7 long, equal in eight specimens, left one longer in two specimens: spicule ratio 1:0.9–1.0, Caudal papillae 31 to 32 pairs: 27 to 28 pre-cloacal pairs, four post-cloacal pairs, one para-anal papilla, doubled. Distinct medioventral pre-cloacal organ, papillated. Modified annules on ventral surface, beginning near anus, extending anteriorly 2.0–6.1 (Fig. 82B). Tail flexed ventrad, without spines.

Females: body 25–69 long by 0.5–1.7 wide. Preventriculus 2.6–7.2, ventriculus 0.173–0.362, ventricular appendix 0.6–4.0, and intestinal caecum 1.5–5.1 long. Vulva opening 7.3–35.1 from anterior end. Ovaries rarely extending anteriorly to vulva level. Eggs 0.018–0.063 in diameter. Tail usually without spines.

Site: stomach

Host: *Xiphias gladius*

Distribution: Atlantic

Records: Nigrelli 1938; Tibbo *et al.* 1961; Iles 1971; Hogans *et al.* 1983

***Hysterothylacium magnum* (Smedley, 1934) Deardorff & Overstreet, 1981**

Synonyms: *Contracaecum magnum* Smedley, 1934; *Thynnascaris magnum* (Smedley, 1934) Margolis & Arthur, 1979

Comments: as noted by McDonald & Margolis (1995), Margolis & Arthur (1979) listed a previous Canadian record as *Thynnascaris magna*. Deardorff & Overstreet (1981) considered the genus *Thynnascaris* to be a junior synonym of *Hysterothylacium* and listed the species as *H. magnum* n. comb. In agreement with McDonald & Margolis (1995) the validity of this species requires re-assessment (see also Comments on *H. melanogrammi* below).

Site: ?

Hosts: *Apodichthys flavidus*; *Leptocottus armatus*; *Ophiodon elongatus*

Distribution: Pacific

Record: Smedley 1934

***Hysterothylacium melanogrammi* (Smedley, 1934) Deardorff & Overstreet, 1981**

Synonyms: *Contracaecum melanogrammi* Smedley, 1934; *Thynnascaris melanogrammi* (Smedley, 1934) Margolis & Arthur, 1979

Comments: as noted by McDonald & Margolis (1995), Margolis & Arthur (1979) listed a previous Canadian record as *Thynnascaris melanogrammi*. Deardorff & Overstreet (1981) considered the genus *Thynnascaris* to be a junior synonym of *Hysterothylacium* and listed the species as *H. melanogrammi* n. comb. In agreement with McDonald & Margolis (*op. cit.*) the validity of this species requires re-assessment (see also Comments on *H. magnum* above).

Site: intestinal lumen

Host: *Melanogrammus aeglefinus*

Distribution: Atlantic

Record: Smedley 1934

***Hysterothylacium reliquens* (Norris & Overstreet, 1975) Deardorff & Overstreet, 1981**

Synonym: *Thynnascaris reliquens* Norris & Overstreet, 1975

Description (after Deardorff & Overstreet 1981). With characteristics of the genus. Body reaching greatest width near midbody. Cuticle with inconspicuous annulations and minute lateral alae. Alae become more apparent at levels behind rectum. Lips approximately equal in size, all longer than wide; flanges constricted near middle of lip; pulp pedunculated. Interlabia with height equal to or slightly greater than width at base. Interlabial grooves absent (Fig. 83A). Preventriculus 11–13% of body length. Ventriculus narrower than widest level of preventriculus. Usually longer than broad; ventricular appendix departing without angulation from posterior portion of ventriculus. Nerve ring located at anterior 16–28% of preventriculus. Excretory pore at or immediately posterior to level of nerve ring. Tail with spined conical mucron.

Males: body 25–40 long by 0.5–0.9 wide. Preventriculus 3.3–4.5, ventriculus 0.141–300, ventricular appendix 1.2–1.7, and intestinal caecum 0.315–598 long. Spicules 1.7–2.4 long, relative length varies: spicule ratio 1:0.6–1.3. Caudal papillae 27 to 33 pairs: 23 to 29 pre-cloacal pairs, four to five post-cloacal pairs with 3rd pair from tail end doubled; para-anal papillae lacking. Distinct medio-ventral organ, papillated. Tail reflexed ventrad, 0.123–0.185 long, including multispinous process (Fig. 83B).

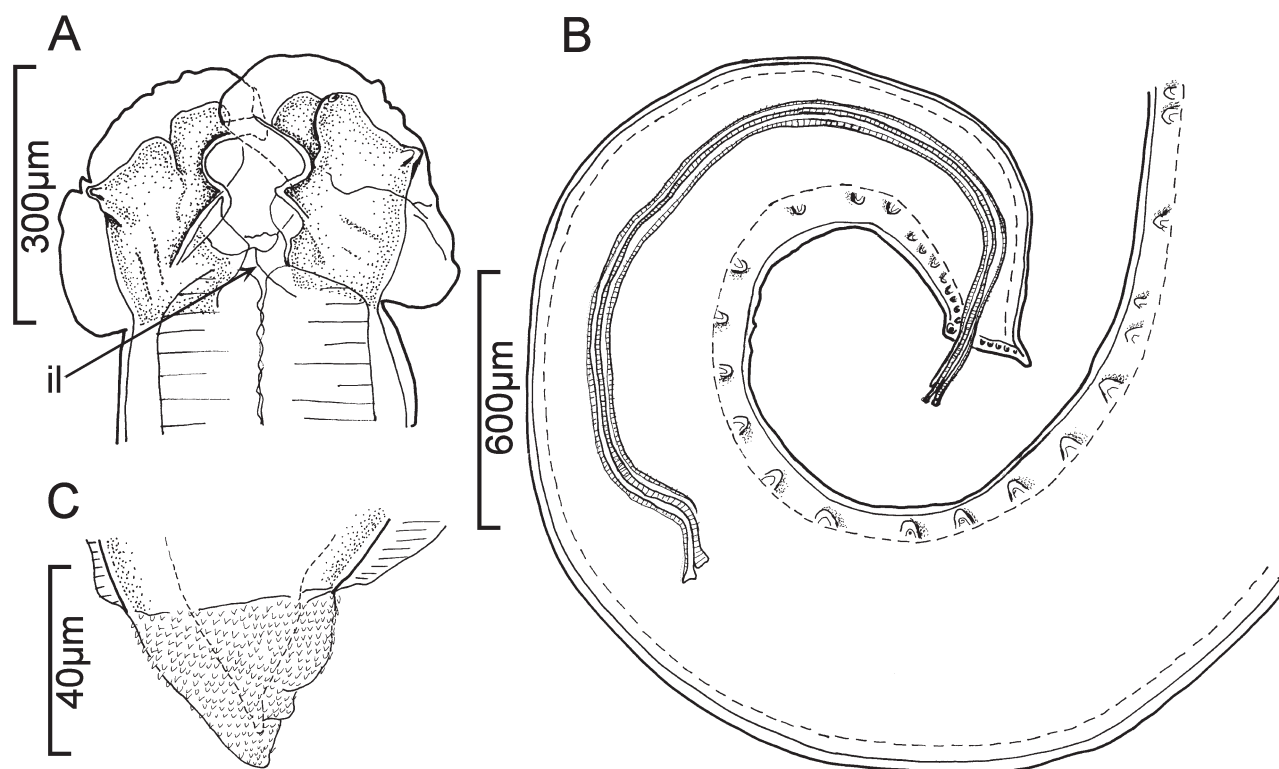


FIGURE 83. *Hysterothylacium reliquens* (Norris & Overstreet, 1975) Deardorff & Overstreet, 1981. A. head, lips, ventral view showing interlabium (il); B. male, posterior end showing caudal papillae, lateral view; C. multispinous process on tail tip, lateral view. (Redrawn from Deardorff & Overstreet 1981)

Females: body 21–44 long by 0.5–1.1 wide. Preventriculus 2.9–5.0, ventriculus 0.142–0.286, ventricular appendix 1.0–2.9, and intestinal caecum 0.394–0.788 long. Vulva without protruding lips, opens 6.5–17.0 from anterior end. Ovaries rarely extend beyond anterior level of vulva. Tail 0.370–0.574 long, including multispinous process (Fig. 83C).

Site: stomach

Host: *Xiphias gladius*

Distribution: Atlantic

Record: Hogans *et al.* 1983

*****Hysterothylacium* sp.**

Synonym: *Thynnascaris* sp.

Sites: alimentary tract, body cavity, mesenteries

Hosts: *Alosa aestivalis* (8, 14); *Alosa pseudoharengus* (8, 14); *Ambloplites rupestris* (1); *Boreogadus saida* (6); *Catostomus columbianus* (4); *Coregonus clupeaformis* (4); *Cottunculus microps* (7); *Cottus aleuticus* (4); *Culaea inconstans* (11); *Fundulus diaphanus* (10); *Gadus morhua* (3, 9); *Gasterosteus aculeatus* (10); *Lepomis macrochirus* (10); *Lycodes esmarkii* (7); *Lycodon mirabilis* (7); *Macrourus berglax* (7); *Mallotus villosus* (5); *Melanogrammus aeglefinus* (9); *Merluccius bilinearis* (9); *Morone americana* (10); *Nezumia bairdii* (7); *Oncorhynchus mykiss* (4); *Oncorhynchus nerka* (4); *Osmerus mordax* (12); *Pleuronectidae* gen. sp. (9); *Pollachius virens* (9); *Prosopium williamsoni* (4); *Ptychocheilus oregonensis* (4); *Salvelinus fontinalis* (2, 13); *Salvelinus malma* (4); *Scomber scombrus* (9); *Sebastes* sp. (9); *Synaphobranchus kaupii* (7)

Distribution: Atlantic, British Columbia, Labrador, New Brunswick, Nunavut, Ontario, Quebec

Records: 1. Szuks 1980 (AT); 2. G. A. Black 1981a (QC); 3. Appy & Burt 1982 (AT); 4. Anon. 1984 (BC); 5. Pålsson & Beverley-Burton 1984 (AT); 6. Bradstreet *et al.* 1986 (NU); 7. Houston & Haedrich 1986 (AT); 8. Landry *et al.* 1986 (NB); 9. Morrison *et al.* 1986 (AT); 10. Dechtiar & Christie 1988 (ON); 11. Dechtiar *et al.* 1988 (ON); 12. Landry & Hare 1990 (AT); 13. Marcogliese & Cone (LB); 14. Landry *et al.* 1992 (AT)

***Raphidascaris* Railliet & Henry, 1915**

Synonyms: *Hysterothylacium* Ward & Magath, 1917; *Ichthyascaris* Wu, 1949; ?*Neogoezia* Kreis, 1937

Preamble: *Raphidascaris acus* is the only species of the genus known from Canadian fishes. The life cycle of *R. acus* was discussed by J. D. Smith (1984b) and Moravec (2013) and involves predatory fishes as final hosts, and various invertebrates and fishes as paratenic or intermediate hosts. Adult and larval stages of *R. acus* are described below.

Generic diagnosis (after Moravec 2013). Raphidascaridinae. Large nematodes, widest in midbody. Cuticle with distinct striations. Lips well developed, of complex structure. Interlabia rudimentary or absent. Excretory pore slightly behind nerve ring level. Narrow lateral alae may be present. Preventriculus muscular; ventriculus almost spherical; posteriorly directed ventricular appendix present. Intestinal caecum absent. Spicules subequal, arcuate, alate. Caudal papillae numerous. Vulva anterior to mid-length of body. Oviparous. Parasites of marine and fresh-water fishes.

***Raphidascaris acus* (Bloch, 1779) Railliet & Henry, 1915**

Synonyms: *Raphidascaris canadensis* Smedley 1933; *Raphidascaris laurentianus* Richardson, 1937; *Raphidascaris alius* Lyster, 1940

Description (after J. D. Smith 1984a). With characteristics of the genus.

Males: 31.5–39.5 (mean 35.3) long, 0.063–0.83 (0.69) maximum width. Lips 0.092–0.118 (0.102) long. Small triangular elevation present between bases of subventral lips (Fig. 84A). Nerve ring 0.63–0.83 (0.69) and excretory pore 0.73–0.88 (0.80) from anterior end. Preventriculus 3.45–4.11 (3.73) long. Ventriculus and ventricular appendix 1.44–2.07 (1.80) long (Fig. 84B). Testis tightly coiled, anterior end 6.05–7.84 (6.91) from anterior end of worm. *Vas efferens* short. Seminal vesicle broad and thin-walled. Ejaculatory duct 1.70–2.57 (2.19) long. Left spicule 0.586–0.802 (0.686) and right spicule 0.544–0.773 (0.681) long. Gubernaculum absent. Caudal papillae extending 3.10–4.27 (3.70) anterior to anus: 16–21 (18) pre-cloacal pairs, two pairs or one pair doubled ad-cloacal, and four pairs post-cloacal. Tail conical, 0.235–0.291 (0.250) long (Fig. 84C). Phasmids lateral, 0.067–0.140 (100) from tip of tail.

Females: 40.5–49.2 (44.5) long, 0.81–1.07 (0.93) maximum width. Lips 0.93–0.132 (0.117) long. Nerve ring 0.60–0.74 (0.68) and excretory pore 0.75–0.84 (0.78) from anterior end. Preventriculus 3.51–4.62 (4.18) long.

Ventriculus and ventricular appendix 1.37–2.23 (1.83) long. Vulva 9.83–11.65 (10.85) from anterior end. Didelphic, opisthodelphic, with many eggs, 0.092–0.111 (0.101) x 0.083–0.101 (0.092). Oviducts ascending and descending, not extending anterior to vulva. Ovaries long, much folded, mainly posterior to uterus. Tail conical, 0.50–0.73 (0.61) long. Phasmids 0.18–0.26 (0.22) from tip of tail. Site: intestinal lumen

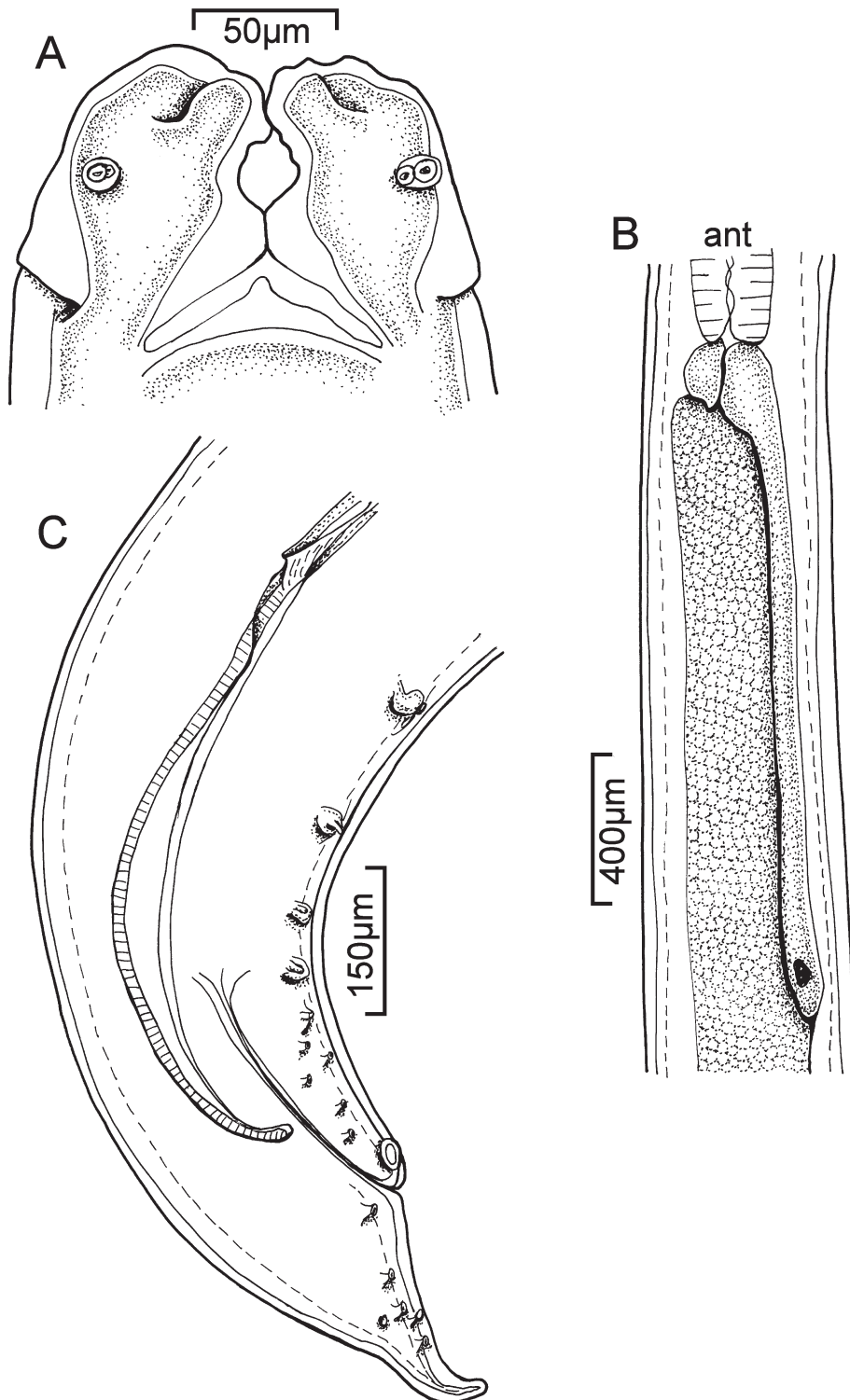


FIGURE 84. *Raphidascaris acus* (Bloch, 1779) Railliet & Henry, 1915. A. head showing cuticular elevation, ventral view; B. ventriculus and ventricular appendix, lateral view; C. male, posterior end, lateral view. (Redrawn from J. D. Smith 1984a)

Hosts: *Catostomus catostomus* (25); *Catostomus commersonii* (24, 44); *Chrosomus eos* (44); *Coregonus artedii* (24); *Coregonus clupeaformis* (15, 23, 24, 25, 36); *Esox lucius* (1, 4, 5, 7, 8, 9, 10, 11, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 28, 30, 31, 32, 35, 37, 38, 39, 40, 43); *Esox masquinongy* (6, 22, 34); *Hiodon alosoides* (39, 43); *Lota lota* (25, 33, 45); *Micropterus dolomieu* (25); *Oncorhynchus gorbuscha* (29); *Oncorhynchus mykiss* (26); *Perca flavescens* (12, 23, 24, 27, 28, 32, 39, 42, 43); *Salvelinus fontinalis* (2, 3, 25, 26, 41, 44); *Sander vitreus* (24, 25, 27, 30, 39, 43, 45)

Distribution: Alberta, Labrador, Manitoba, Northwest Territories, Ontario, Quebec, Saskatchewan, Yukon Territory

Records: 1. Smedley 1933 (MB, SK); 2. Richardson 1937 (QC); 3. Lyster 1940 (QC); 4. Miller 1945 (AB); 5. Rawson 1951 (NT); 6. Choquette 1951c (QC); 7. Stewart-Hay 1951a (MB); 8. Stewart-Hay 1951b (MB); 9. Stewart-Hay 1952a (MB); 10. Stewart-Hay 1952b (MB); 11. Stewart-Hay 1953a (MB); 12. Dickson 1964 (MB); 13. Chinniah & Threlfall 1978 (LB); 14. Gordon *et al.* 1978 (QC); 15. Pybus & Samuel 1978 (AB); 16. Thompson & Threlfall 1978 (QC); 17. Kinnis & Curtis 1981 (QC); 18. Leong & Holmes 1981 (AB); 19. Samuel 1981 (AB); 20. J. D. Smith & Anderson 1981 (ON); 21. J. D. Smith & Anderson 1982 (ON); 22. Anthony 1983 (ON); 23. McAllister & Mudry 1983 (AB); 24. Poole 1983 (MB); 25. J. D. Smith 1984a (ON); 26. J. D. Smith 1984b (ON); 27. Poole & Dick 1985 (MB); 28. Samuel 1985 (AB); 29. Anthony 1986 (ON); 30. Poole & Dick 1986 (MB); 31. Shostak & Dick 1986 (MB); 32. J. D. Smith 1986 (ON); 33. Anthony 1987 (ON); 34. Dechtiar & Christie 1988 (ON); 35. Dechtiar *et al.* 1988 (ON); 36. Stock 1988 (AB); 37. Szalai & Dick 1988 (MB); 38. Shostak & Dick 1989 (MB); 39. Szalai 1989 (MB); 40. Szalai & Dick 1989 (MB); 41. Marcogliese & Cone 1991a (LB, QC); 42. Szalai & Dick 1991 (MB); 43. Szalai *et al.* 1992a (MB); 44. Dubois *et al.* 1996 (QC); 45. Baldwin & Goater 2003 (AB)

****Raphidascaris acus* (Bloch, 1779) Railliet & Henry, 1915**

Synonyms: *Raphidascaris canadensis* Smedley 1933; *Raphidascaris laurentianus* Richardson, 1937; *Raphidascaris alius* Lyster, 1940

Description (after J. D. Smith 1984b).

L4 males: mean 2.777 (range 2.522–3.197) long; L4 females: 2.961 (2.348–3.393) long. Three lips present, equal in length. Single interlabium between subventral lips, much reduced in adults. Lateral interlabia absent. Four double papillae, two on dorsal lip, one on each subventral lip. Lateral amphid and single papilla on each subventral lip. Cuticle with distinct striations. Lateral alae from base of lips to tail. Deirids small, at level of excretory pore. Tail long, conical, pointed (Fig. 85A). Phasmids in midregion of tail. Male gonad from slightly anterior of midpoint of larva to rectum. Testis thin-walled. Posterior portion of gonad with walls of low cuboidal cells. Spicule pouches extending dorsally and anteriorly from dorsal wall of rectum. Developing spicules narrow, not cuticularized (Fig. 85A). Female gonad 20–25% of length of larva. Vagina slightly anterior to midpoint of larva (Fig. 85B). Uterus dividing into two posteriorly directed branches, slightly posterior from vagina. Oviduct proximal to uterus, short. Ovaries straight, thin-walled, filled with large germinal cells.

L3: males 1.682 (1.444–2.056) long; females 1.925 (1.690–2.248) long. Anterior end with ventral boring tooth, four large papillae subdorsally and subventrally, pair of single papillae, and pair of amphids laterally. Lips absent. Lateral alae from anterior end to tail, widest in anterior third. Cuticle with fine transverse striations. Deirids small, at level of excretory pore. Tail conical, pointed. Phasmids in midregion of tail. Three rectal cells around anterior part of rectum. Sexes distinct. Vaginal primordium an ovoid mass of cuboidal cells, embedded in ventral body wall, near midpoint of larva. Two ovaries extending posteriorly from vagina. Gonad in male straight, elongate, ventral to intestine in posterior quarter of body.

L2: body 0.899 (0.787–1.009) long. Anterior end bluntly rounded with 4 large papillae subdorsally and subventrally. Mouth opening approximately triangular in outline. Conical boring tooth at ventral apex of mouth opening. Lips absent. Lateral alae narrow. Cuticular striations not seen. Deirids small, at level of excretory pore which is slightly posterior to nerve ring. Preventriculus claviform. Ventriculus about as long as wide, with posteriorly directed ventricular appendix. Genital primordium ovoid, comprising four to eight cells. Tail conical, pointed.

For detailed dimensions and disposition of the various organs in L4, L3 and L2 see J. D. Smith (1984b).

Site: viscera

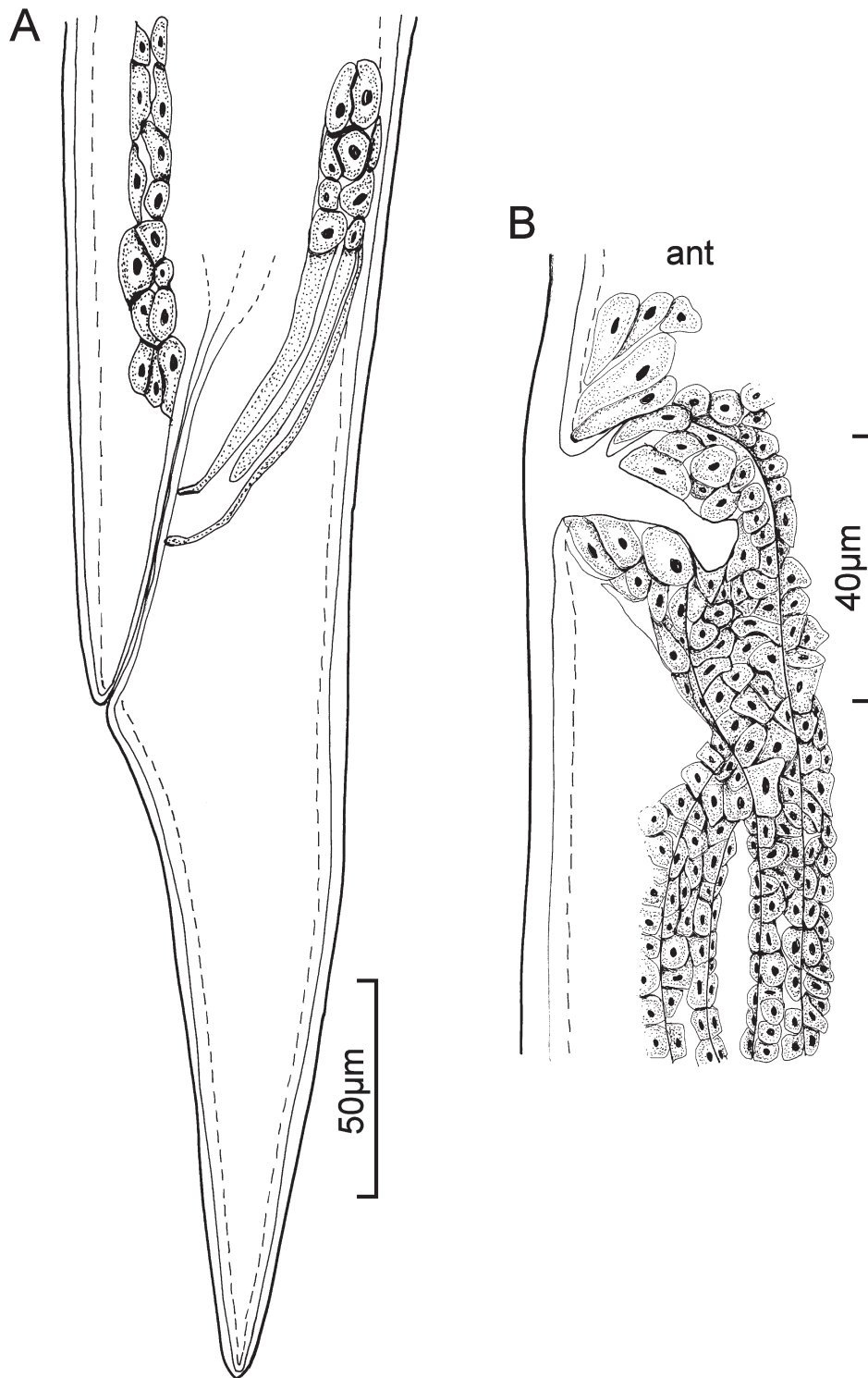


FIGURE 85. **Raphidascaris acus* (Bloch, 1779) Railliet & Henry, 1915. A. male L4, posterior end showing developing spicules and vas deferens, lateral view; B. female L4, vagina, lateral view. (Redrawn from J. D. Smith 1984b)

Hosts: *Acipenser fulvescens* (25); *Ambloplites rupestris* (10, 17); *Catostomus commersonii* (7, 16, 21, 23); *Coregonus artedii* (7, 21, 23, 29); *Coregonus clupeaformis* (1, 7, 13, 19, 29); *Cottus bairdii* (19); *Cottus cognatus* (1); *Esox lucius* (1, 15, 16, 29); *Etheostoma caeruleum* (11); *Etheostoma exile* (16); *Etheostoma nigrum* (11); *Fundulus diaphanus* (16); *Hiodon alosoides* (21, 23); *Ictalurus punctatus* (10); *Lepomis gibbosus* (20); *Lota lota* (29); *Morone chrysops* (18); *Moxostoma anisurum* (21); *Myoxocephalus thompsonii* (33); *Notemigonus crysoleucas* (16); *Notropis hudsonius* (21, 23); *Perca flavescens* (4, 5, 7, 8, 9, 11, 12, 14, 16, 17,

18, 19, 20, 21, 22, 23, 24, 26, 27, 28, 29, 30, 31, 32, 33); *Percina caprodes* (21, 23); *Percopsis omiscomaycus* (21, 23); *Pimephales notatus* (16); *Pimephales promelas* (16); *Ptychocheilus oregonensis* (2, 6); *Pungitius pungitius* (3); *Salvelinus namaycush* (29); *Sander canadensis* (21, 23); *Sander vitreus* (7, 12, 14, 21, 23); *Thymallus arcticus* (1, 29); *Tinca tinca* (34); *Umbra limi* (16)

Distribution: Alberta, British Columbia, Labrador, Manitoba, Ontario, Quebec, Yukon Territory

Records: 1. Arthur *et al.* 1976 (YT); 2. Anon. 1978 (BC); 3. Leong & Holmes 1981 (AB); 4. J. D. Smith & Anderson 1981 (ON); 5. J. D. Smith & Anderson 1982 (ON); 6. Arai & Mudry 1983 (BC); 7. Poole 1983 (MB); 8. Poole & Dick 1984 (MB); 9. Baker 1984b (ON); 10. J. D. Smith 1984a (ON); 11. J. D. Smith 1984b (ON); 12. Poole & Dick 1986 (MB); 13. Samuel 1985 (AB); 14. Poole & Dick 1985 (MB); 15. Shostak & Dick 1986 (MB); 16. J. D. Smith 1986 (ON); 17. Dechtiar & Lawrie 1988 (ON); 18. Dechtiar & Nepszy 1988 (ON); 19. Dechtiar *et al.* 1988 (ON); 20. Dechtiar *et al.* 1989 (ON); 21. Szalai 1989 (MB); 22. Szalai & Dick 1991 (MB); 23. Szalai *et al.* 1992a (MB); 24. Szalai *et al.* 1992b (MB); 25. Choudhury & Dick 1993 (MB); 26. Zelmer 1994 (AB); 27. Zelmer & Arai 1998 (AB); 28. Carney & Dick 2000 (MB); 29. Johnson & Dick 2001 (ON); 30. Baldwin & Goater 2003 (AB); 31. Zelmer & Arai 2004 (AB); 32. Marcogliese *et al.* 2005 (QC); 33. Carney *et al.* 2009 (ON); 34. Marcogliese *et al.* 2009 (QC)

*****Raphidascaris* sp.**

Sites: alimentary tract, liver, musculature

Hosts: *Acipenser fulvescens* (26, 28); *Coregonus artedi* (14, 15, 17); *Coregonus clupeaformis* (3, 14, 16, 17, 20, 21, 23); *Coregonus nasus* (27); *Esox lucius* (2, 3, 5, 8, 12, 14, 19, 20, 21, 23); *Morone chrysops* (22); *Perca flavescens* (1, 3, 15, 20, 23); *Pungitius pungitius* (12); *Salmo salar* (6, 7, 9, 10, 11, 13, 18); *Salvelinus fontinalis* (16, 24, 25); *Salvelinus namaycush* (12, 16); *Sander vitreus* (3, 4)

Distribution: Alberta, Hudson Bay Drainage, Labrador, Manitoba, New Brunswick, Northwest Territories, Ontario, Quebec, Saskatchewan

Records: 1. Richardson 1937 (QC); 2. McLeod 1943 (MB); 3. McLeod 1944 (MB); 4. Stewart-Hay 1951b (MB); 5. Stewart-Hay 1953c (MB); 6. Pippy 1967 (LB); 7. Pippy 1969 (AT); 8. Threlfall & Hanek 1970b (LB); 9. Hare 1975 (NB); 10. Hare & Burt 1975a (NB); 11. Hare & Burt 1975b (NB); 12. Leong 1975 (AB); 13. Hare & Burt 1976 (NB); 14. Watson 1977 (MB); 15. Anthony 1978b (ON); 16. Chinniah & Threlfall 1978 (LB); 17. Watson & Dick 1979 (MB); 18. Pippy 1980 (NB); 19. Watson & Dick 1980 (MB); 20. Samuel 1981 (AB); 21. McAllister & Mudry 1983 (AB); 22. Anthony 1984 (ON); 23. Samuel 1985 (AB); 24. Frimeth 1987a (NB); 25. Frimeth 1987b (NB); 26. Choudhury *et al.* 1990 (MB); 27. Choudhury & Dick 1997 (NT); 28. Choudhury & Dick 1998 (HBD, MB)

Superfamily SEURATOIDEA Chabaud, Campana-Rouget & Brygoo, 1959

Key to Families of SEURATOIDEA

- 1 Buccal cavity absent or, if present, derived from cheilostom; cuticle constituting walls of cheilostom having same structure and staining reactions as external body cuticle Quimperiidae
- Buccal cavity formed from modifications of anterior end of oesophagus (oesophastom); walls of oesophastom surrounded by oesophageal tissue Cucullanidae

Family CUCULLANIDAE Cobbold, 1864

Key to genera of CUCULLANIDAE

- 1 Mouth markedly inclined dorsally; cuticular lining of oesophastom consisting of complex set of thickened cuticularized pieces separated by sutures; cuticularized frame around mouth opening absent. *Truttaedaenitis*
- Mouth opening perpendicular to body axis or slightly inclined dorsally; cuticularized plates of oesophastom few in number and separated by simple Y-shaped sutures; mouth opening supported by peribuccal cuticularized frame to which are joined some

	cuticularized pieces inserted into adjacent oesophageal muscles	2
2	Intestinal caecum absent	<i>Cucullanus</i>
-	Intestinal caecum present	3
3	Intestinal caecum dorsal; pre-cloacal sucker absent	<i>Dichelyne</i>
-	Intestinal caecum ventral; pre-cloacal sucker present	<i>Cucullanellus</i>

***Truttaedacnitis* Petter, 1974**

Synonyms: *Dacnitis* Törnquist, 1931 *nec* Dujardin, 1845; *Bulbodacnitis* Maggenti, 1971 *nec* Lane, 1916

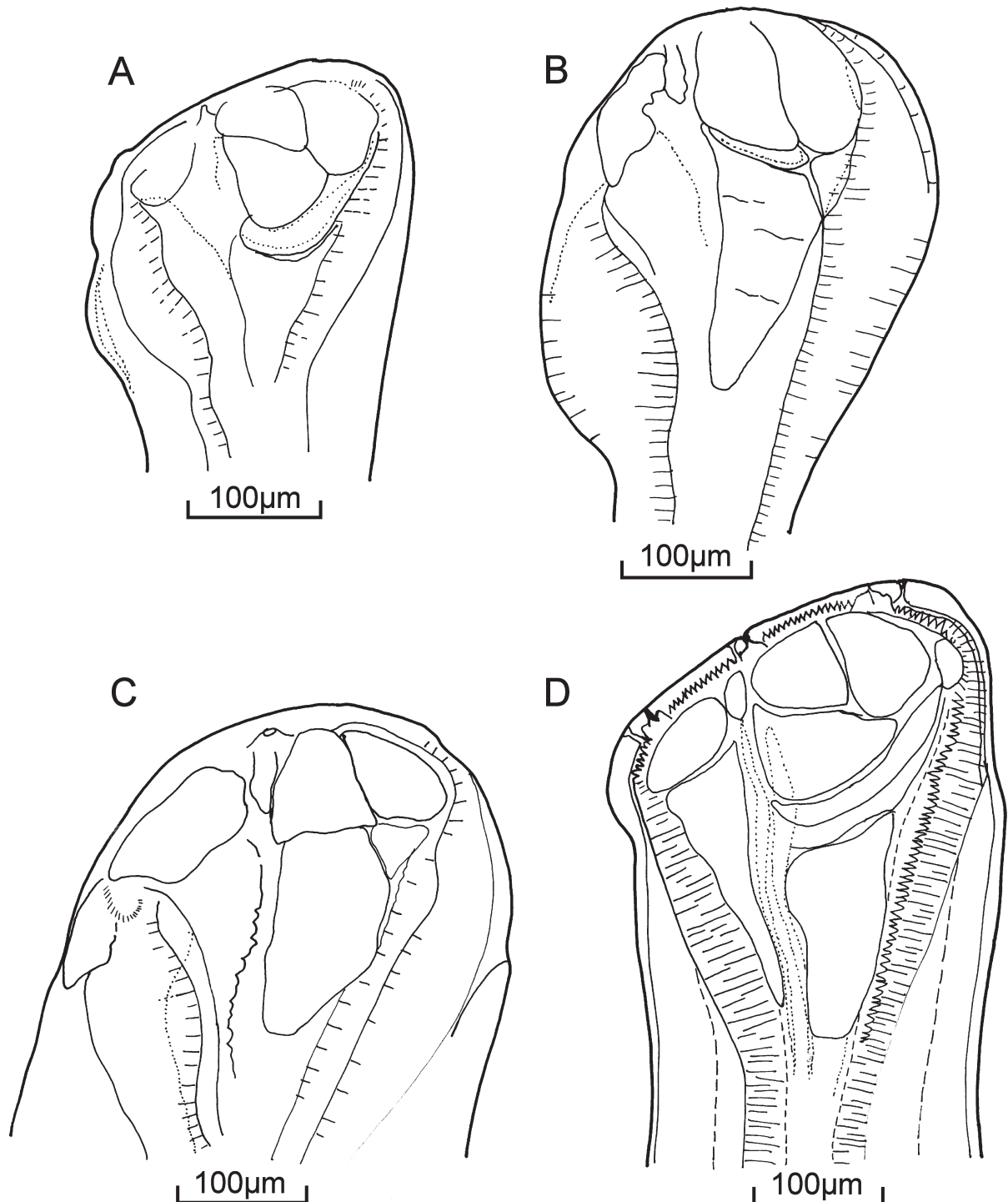


FIGURE 86. *Truttaedacnitis* spp.: heads showing cephalic plates. A. *T. truttae*; B. *T. sphaerocephala*; C. *T. clitellarius*; D. *T. pybusae*. (A., B. and C. redrawn from Choudhury & Dick 1996b; D. redrawn and rotated from Pybus *et al.* 1978a)

Preamble: Choudhury & Dick (1996b) analysed phylogenetically the genus *Truttaedacnitis* referring *inter alia* to the morphology and arrangement of the various cephalic plates. Because the homology of some of the cephalic plates could not be determined, these workers did not use the total number of plates in their analysis. Illustrations of the plates in the four species of *Truttaedacnitis* are given here (Fig. 86).

Generic diagnosis (after Berland 1970). Cucullanidae. Mouth a dorso-ventral slit, directed antero-dorsally, surrounded by cuticular collarette bearing conspicuous or inconspicuous “teeth”. A dorsal cephalic swelling (tubercle) more or less pronounced. Oesophagus with three pairs of longitudinal rods and serrated plates diverging in pseudobuccal capsule, leaving between them thick cuticular plates separated by narrow sutures forming a characteristic pattern. Vulva with conspicuous lips. Male with ventral pre-cloacal sucker. Spicules equal or sub-equal, straight or bent. Short gubernaculum. Eleven pairs caudal papillae.

Key to species of *Truttaedacnitis*

- | | | |
|---|---|--------------------------|
| 1 | Excretory pore situated at level of pseudobuccal capsule; oral collarette structures weak | 2 |
| - | Excretory pore situated behind nerve ring; oral collarette structures conspicuous | 3 |
| 2 | Spicules straight | <i>T. clitellarius</i> |
| - | Spicules bent | <i>T. sphaerocephala</i> |
| 3 | Dorsal cephalic ridge absent | <i>T. pybusae</i> |
| - | Dorsal cephalic ridge present | <i>T. truttae</i> |

Truttaedacnitis clitellarius (Ward & Magath, 1917) Petter, 1974

Synonym: *Cucullanus clitellarius* Ward & Magath, 1917

Description (after Choudhury & Dick 1996a). With characteristics of the genus. Body moderately robust, cephalic end rounded, cuticle with transverse striations. Posterior part of body often curved ventrally. Narrow lateral alae beginning in cervical region, terminating at anal region. Mouth opening spindle-shaped, with three conspicuous papillae on either side—the central one likely an amphid. Mouth opening bordered by transparent cuticular collarette bearing weak longitudinal rib-like structures (“teeth”). Inner circle of three small papillae present. Two bud-shaped deirids, one on either side, often asymmetrical, adjacent to lateral alae, and posterior to nerve ring. Tail conical, gently tapering, bearing mucron. Hemizonid posterior to nerve ring. Oesophagus muscular, clavate, expanded anteriorly to form pseudobuccal capsule. Bilaterally symmetrical cephalic plates present, separated by narrow sutures and attached to thickened cuticular plates of pseudobuccal capsule (Fig. 86C). Oesophageal lumen lined by cuticle, each side of triradiate lumen thickened to give appearance of “longitudinal rods” embedded into oesophageal musculature. Oesophago-intestinal junction guarded by cuticular folded valve. Excretory pore at about mid-level of pseudobuccal capsule (Fig. 87A). Excretory duct long, cuticular, extending posteriorly along ventral body wall past nerve ring to first half of oesophagus, with prominent nucleus present immediately posterior to base of excretory duct (Fig. 87A).

Males: 13.5 (9.6–16.9) long; maximum width 0.40 (0.24–0.59). Nerve ring 0.585 (0.526–0.640) from anterior end. Oesophagus 1.35 (1.10–1.55) long. Tail 0.428 (0.301–0.564) long. Single testis originating posteriorly, extending anteriorly and looping back on itself. Posterior pre-cloacal sucker bordered by radially situated muscle bands, 1.70 (1.25–2.10) from posterior end (Fig. 87B). Spicules equal or slightly sub-equal, gouge shaped with median serrated margins; left spicule 1.12 (0.90–1.30) long, right one 1.14 (0.87–1.35) long. Gubernaculum with Y-shaped sclerotized body, 0.139 (0.101–0.172) long. Eleven pairs of sessile caudal papillae: four pairs pre-cloacal, one pair ad-cloacal, and six pairs post-cloacal, of which one pair are phasmids. Median papilla immediately anterior to anterior margin of cloacal opening (Fig. 87B).

Females: 15.1 (9.9–18.6) long; maximum width 0.43 (0.33–0.53). Nerve ring 0.613 (0.564–0.677) from anterior end. Oesophagus 1.42 (1.15–1.60) long. Tail 0.380 (0.245–0.498) long. Ovaries coiled. Anterior ovary at level of, or posterior to, oesophago-intestinal junction, in anterior third of body. Posterior ovary in posterior fifth of body (Fig. 87C). Oviducts extending beyond vulvar region, reflexing and giving rise to thin-walled uteri containing eggs. Vulval opening a transverse slit. Eggs ovoid, thin-shelled, 0.067 x 0.041–0.079 x 0.049.

Site: intestinal lumen

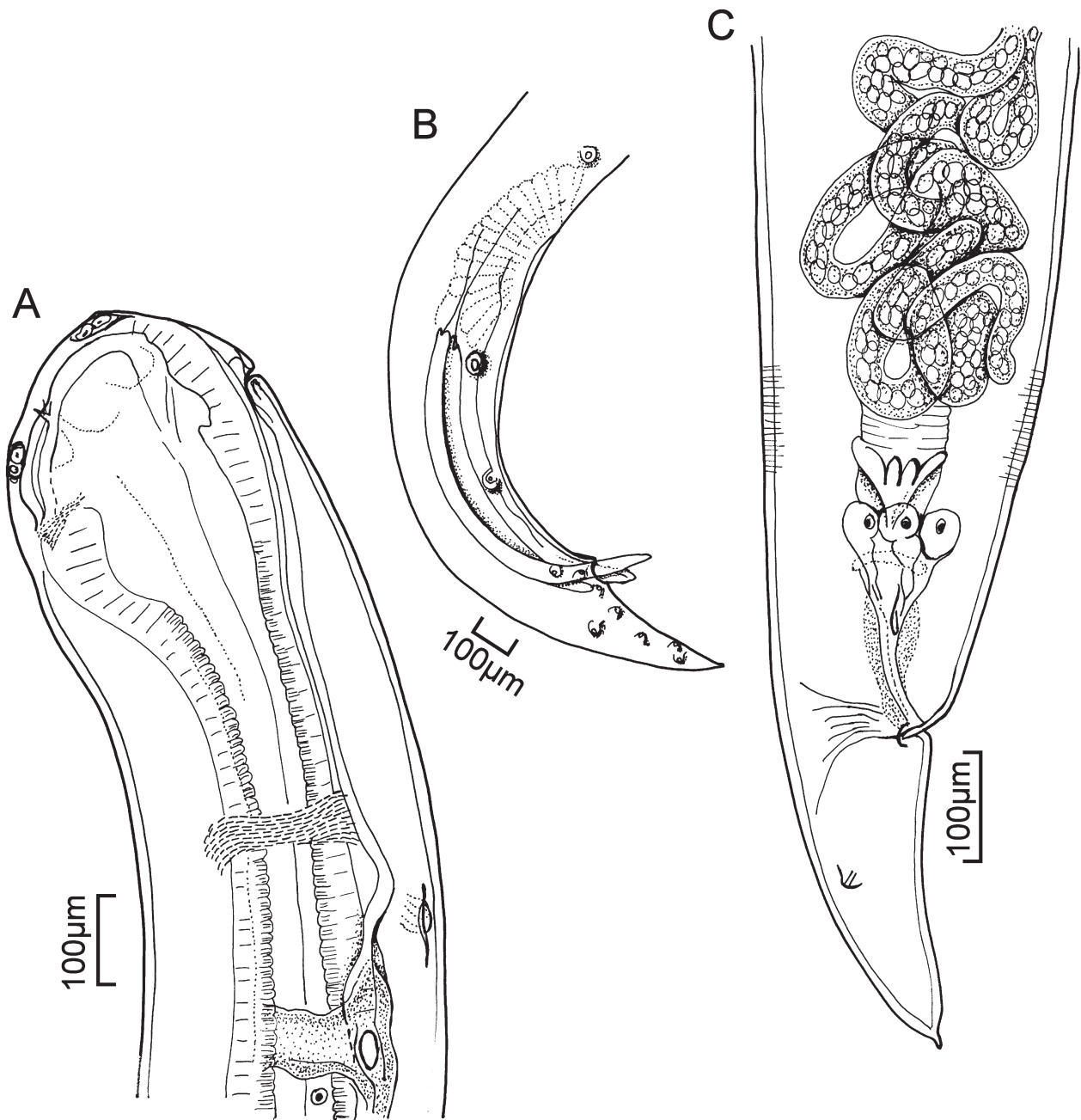


FIGURE 87. *Truttaedacnitis clittellarius* (Ward & Magath, 1917) Petter, 1974. A. male, anterior end showing excretory pore and duct, lateral view; B. male, posterior region showing pre-cloacal sucker, spicules and papillae, lateral view; C. female, posterior end showing posterior coiled ovary, rectal glands, phasmid and mucron, lateral view. (Redrawn from Choudhury & Dick 1996a)

Host: *Acipenser fulvescens*

Distribution: Canada, Central Canada, Hudson Bay Drainage, Manitoba, Ontario, Saskatchewan

Records: Bangham & Hunter 1939 (ON); Bangham 1951 (ON); Bangham 1955 (ON); Anthony 1974 (ON); Dechtiar & Christie 1988 (ON); Choudhury *et al.* 1990 (MB, SK); Swanson *et al.* 1991 (MB); Choudhury & Dick 1993 (CC); Choudhury & Dick 1996a (MB, SK); Choudhury & Dick 1996b (CA); Choudhury & Dick 1998 (HBD)

*****Truttaedacnitis pybusae* Anderson, 1992**

Synonym: *Truttaedacnitis stelmioides* of Pybus, Uhazy & Anderson, 1978

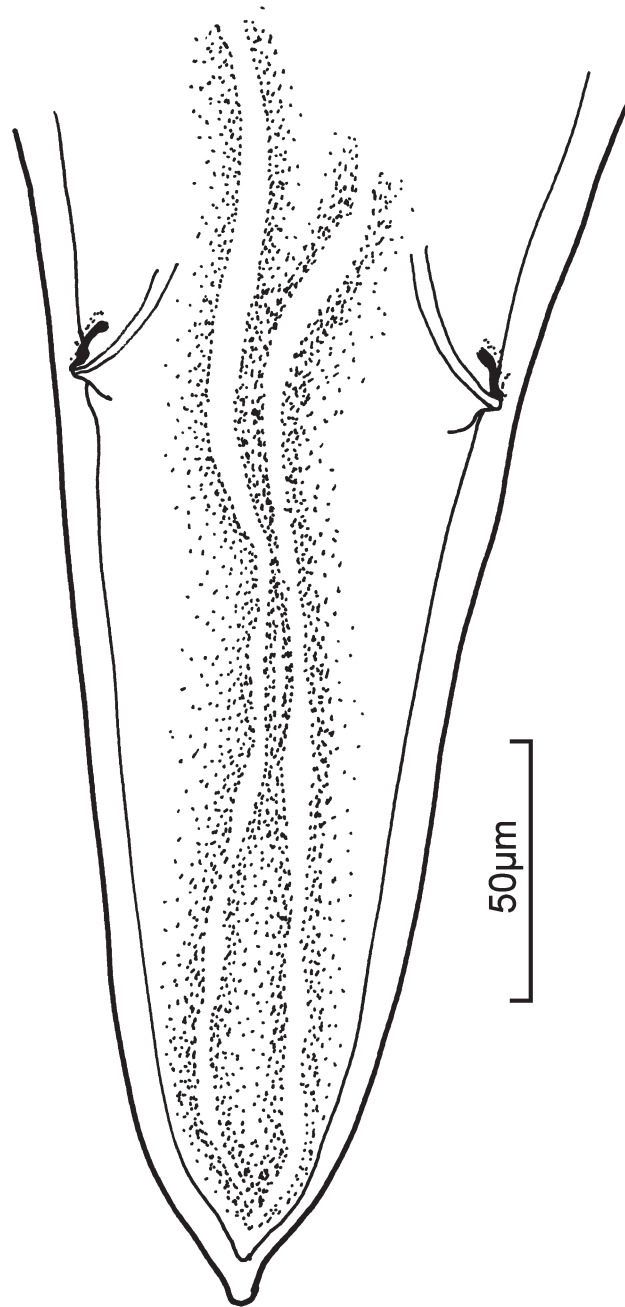


FIGURE 88. ***Truttaedacnitis pybusae* Anderson, 1992. Female, posterior end showing phasmids, ventral view. (Redrawn from Pybus *et al.* 1978a)

Description (after Pybus *et al.* 1978a). With characteristics of the genus. Slender worms with blunt anterior end and pointed, conical tail with small mucron. Cuticle smooth or with fine transverse striations. Lateral alae extend from level of nerve ring to posterior border of pre-cloacal sucker. Deirids behind nerve ring either directly opposite each other or one slightly anterior to the other. Excretory pore behind nerve ring, at same level as, or anterior to, at least one deirid. Mouth opening slit-like or triangular, dorso-ventral in position, surrounded by thin collarette containing 100 to 120 conspicuous cuticular "teeth". Cephalic papillae comprise four prominent double submedian papillae. Fused papillae of unequal size; larger papilla containing central cuticular rod. Amphids lateral. Six small papillae located near oral margin. Oesophagus clavate and muscular, expanding anteriorly around conical pseudobuccal capsule. Dorsal oesophageal gland nucleus prominent near posterior end oesophagus; gland opens in dorsal angle of mouth opening. Subventral oesophageal gland nuclei inconspicuous, opening at nerve ring level. Cuticle lining each angle of triradiate oesophagus thickened into paired longitudinal rods extending from near oral margin to

anterior oesophago-intestinal valve. Oesophageal rods diverge anteriorly to form pseudobuccal cavity. Cuticle lining capsule thickened to form cephalic plates separated by thin sutures (Fig. 86D). Two to four coelomocytes in body cavity.

Males: 10.2 (8.1–12.9) long; maximum width 0.31 (0.26–0.37). Nerve ring 0.370 (0.324–0.465) from anterior end. Oesophagus 0.97 (0.86–1.15) long. Tail 0.287 (0.237–0.367) long. Single testis in posterior third of body, looping anteriorly then reversing. Muscular pre-cloacal sucker lacks cuticularized rim, 8.8 (7.1–11.3) from anterior end. Spicules equal or sub-equal, 0.502 (0.382–0.650) long; cross section of spicules shows three longitudinal hollow areas running entire length. Arrangement of caudal papillae similar to that of *T. clitellarius* above (Fig. 87B). Gubernaculum Y-shaped, 0.087 (0.074–0.104) long.

Females: 11.6 (9.5–14.3) long; maximum width 0.34 (0.26–0.44). Nerve ring 0.397 (0.350–0.470) from anterior end. Oesophagus 1.040 (0.937–1.200) long. Anterior ovary in middle third of body, the posterior one in posterior third. Oviducts looping beyond vulva, then reversing and expanding into uteri. Vulva located behind midbody, anterior lip larger than posterior. Eggs near vagina in morula stage, 0.063–0.087 x 0.051–0.068. Tail bears one pair lateral papilliform phasmids (Fig. 88).

Larvae: Pybus *et al.* (1978b) and Anderson (1996) discussed the transmission of *T. pybusae*, including the morphometry of larvae in lamprey ammocoetes and “transformers”. The biology of the nematode appears to be closely linked to the metamorphosis and maturation of lampreys.

Sites: gills, gonads, intestinal lumen, kidney, liver, mesenteries

Host: *Lethenteron appendix*

Distribution: Ontario

Records: Pybus *et al.* 1978a; Pybus *et al.* 1978b; Anderson 1996

***Truttaedacnitis sphaerocephala* (Rudolphi, 1809) Petter, 1974**

Synonym: *Bulbodacnitis sphaerocephala* (Rudolphi, 1809) Maggenti, 1971

Description (after Choudhury & Dick 1996b, and Moravec 2013). With characteristics of the genus. Moderately large worms with thick cuticle. Anterior end often dorsally flexed and mouth opening markedly oblique. Mouth opening bordered by cuticular collarette bearing weakly developed inconspicuous longitudinal riblike structures (“teeth”). Ventral cephalic ridge traverses ventral side at level of pseudobuccal capsule; excretory pore occurs between the two hemispheres of this ridge. Two very narrow alae extend along anterior part of body, starting below level of posterior end of pseudobuccal capsule. Two broad closely apposed cephalic plates are on either side of the mouth opening (Fig. 86B). The pseudobuccal capsule has a thickened cuticular lining surrounded by musculature that becomes progressively thinner posteriorly. Hemizonid and asymmetrical deirids behind nerve ring. Tail conical. [Measurements in square parentheses are taken from Moravec’s (2013) description of European material.]

Males: 11.9–16.2 long. [11.24–22.71 long; maximum width 0.31–0.48. Nerve ring 0.468–0.640 from anterior end. Oesophagus 1.64–2.12 long. Tail conical, 0.265–0.374 long, pointed tip.] Testis single. Posterior end of body bent ventrally, with well developed pre-cloacal sucker. Spicules equal, bent [0.270–0.440 long] (Fig. 89). [Gubernaculum 0.075–0.096 long.] Arrangement of caudal papillae similar to that of *T. clitellarius* above (Fig. 87B).

Females: 15.9–18.8 long. [17.44–28.56 long; maximum width 0.30–0.48. Nerve ring 0.468–0.640 from anterior end. Oesophagus 1.89–2.28 long. Deirids asymmetrical, 0.075–0.160 from anterior end. Tail 0.374–0.562 long, conical, tip rounded with mucron.] Vulva in posterior half of body, anterior lip large, overlapping posterior lip. Eggs oval, thin-walled, [0.070–0.092 x 0.045–0.064].

Site: spiral valve

Host: *Acipenser oxyrinchus*

Distribution: Atlantic, New Brunswick

Records: Linkletter *et al.* 1977 (AT); Appy & Dadswell 1978 (NB)

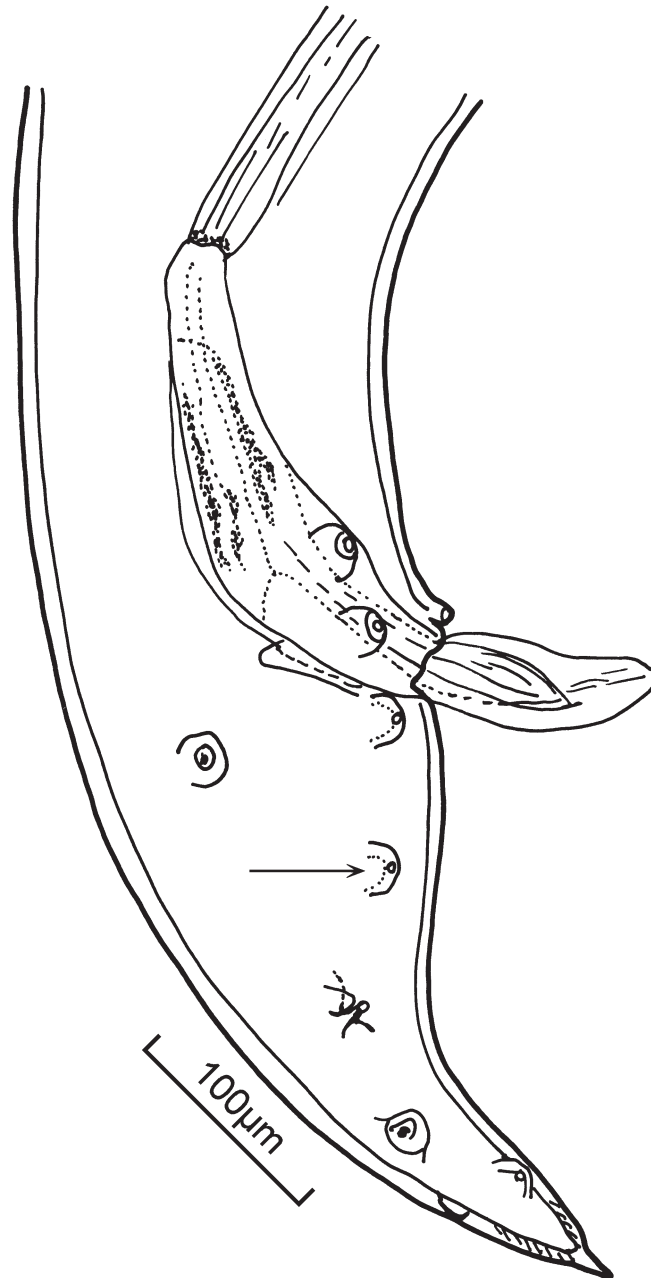


FIGURE 89. *Truttaedacnitis sphaerocephala* (Rudolphi, 1809) Petter, 1974. Male, posterior end showing papillae and bent spicules, lateral view. Arrow indicates the 9th papilla. (Redrawn from Choudhury & Dick 1996b)

*****Truttaedacnitis truttiae* (Fabricius, 1794) Petter, 1974**

Synonyms: *Bulbodacnitis globosa* (Zeder, 1800) Lane, 1916; *Bulbodacnitis occidentalis* Smedley, 1933; *Bulbodacnitis truttiae* (Fabricius, 1794) Maggenti, 1971; *Bulbodacnitis alpinus* Mudry and McCart, 1974; *Truttaedacnitis alpinus* (Mudry and McCart, 1974) Pybus, Uhazy and Anderson, 1978

Description (after Berland 1970, and Mudry & McCart 1974). With characteristics of the genus. Medium sized worms, cuticle moderately thick, minutely striated throughout. Head bulbous, inclined dorsally. Oral aperture bordered by cuticular collarette bearing about 100 small conspicuous “teeth”. Six cephalic papillae surround oral aperture. Pseudobuccal cavity with cephalic plates (Fig. 86A). Excretory pore about midway between nerve ring and oesophago-intestinal junction. Deirids located anterior to excretory pore. Tail conical, bearing button-shaped or nipple-shaped mucron (North American material) or pointed mucron (European material).

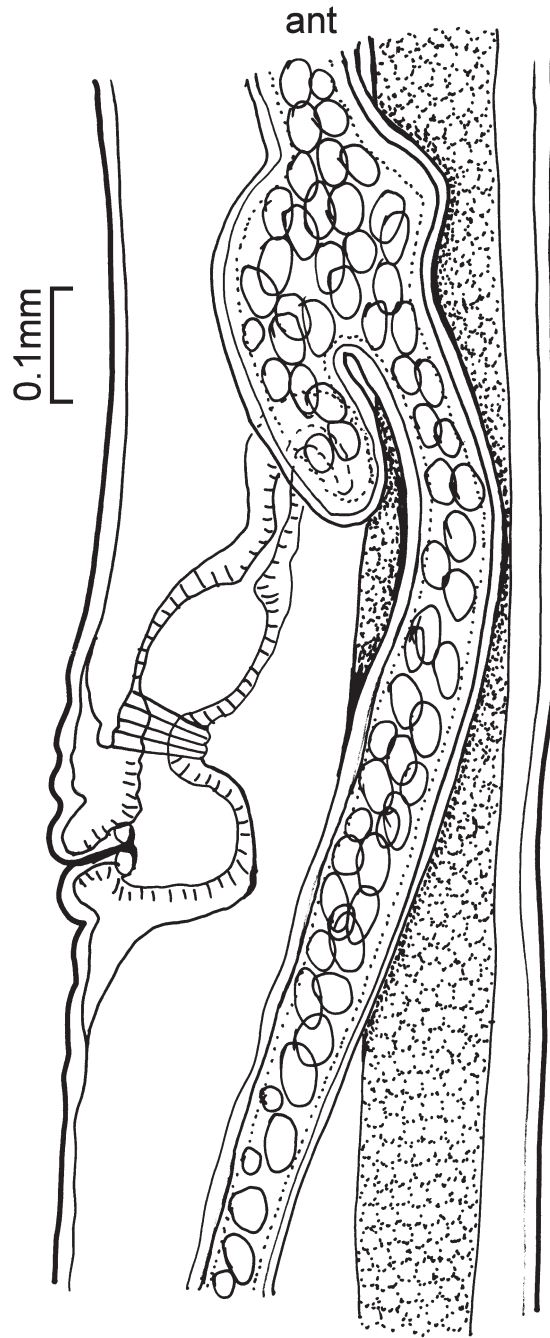


FIGURE 90. ***Truttaedacnitis truttiae* (Fabricius, 1794) Petter, 1974. Female, vulvar region, lateral view. (Redrawn from Mudry & McCart 1974)

Males: 8.37–15.27 long; maximum width 0.25–0.42. Nerve ring 0.374–0.537, and excretory pore 0.584–0.931 from anterior end. Oesophagus clavate, 0.928–1.341 long. Single testis 0.36–2.04 from oesophagus base. Posterior lip of pre-cloacal sucker 0.836–1.251 from tail tip. Spicules equal, 0.455–0.537 long, not overlapping pre-cloacal sucker when fully retracted. Arrangement of caudal papillae similar to that of *T. clitellarius* above (Fig. 87B). Gubernaculum 0.107–0.134 long.

Females: 11.81–18.00 long; maximum width 0.27–0.42. Nerve ring 0.421–0.523, and excretory pore 0.612–0.877 from anterior end. Oesophagus clavate, 1.049–1.375 long. Posterior ovary extends into tail region. Vulva raised, located 7.482–11.080 from anterior end (Fig. 90). Eggs 0.044–0.054 x 0.062–0.083.

Larvae: the variety of hosts from which *Truttaedacnitis truttiae* has been recovered and the extra-alimentary tract sites occupied (see below) suggest that larvae are present, though none appears to have been described *in litt.*

Sites: alimentary tract, gills, gonads, intestinal lumen, kidneys, liver, mesenteries, pyloric caeca

Hosts: *Coregonus clupeaformis* (13); *Oncorhynchus clarkii* (2); *Oncorhynchus mykiss* (1, 2, 7, 8, 9, 10, 11, 12, 13, 19); *Oncorhynchus nerka* (10, 13); *Petromyzon marinus* (3, 4); *Prosopium cylindraceum* (2); *Prosopium williamsoni* (2, 7, 8, 10, 11, 13, 18); *Ptychocheilus oregonensis* (10, 13); *Salvelinus alpinus* (5, 6); *Salvelinus fontinalis* (2, 14, 15, 16, 17, 19); *Salvelinus malma* (2, 8, 10, 11, 13, 19); *Salvelinus namaycush* (7, 8, 11, 13, 19)

Distribution: Alberta, British Columbia, New Brunswick, Ontario, Yukon Territory

Records: 1. Smedley 1933 (BC); 2. Bangham & Adams 1954 (BC); 3. Wilson 1967 (ON); 4. Wilson & Ronald 1967 (ON); 5. Mudry & McCart 1974 (YT); 6. Mudry & McCart 1976 (YT); 7. Mudry & Anderson 1977 (AB); 8. Anon. 1978 (BC); 9. Russell 1980 (BC); 10. Anon. 1981 (BC); 11. Arai & Mudry 1983 (BC); 12. Dunn *et al.* 1983 (BC); 13. Anon. 1984 (BC); 14. Frimeth 1986 (NB); 15. Frimeth 1987a (NB); 16. Frimeth 1987b (NB); 17. Marcogliese & Cone 1991a (NB); 18. Nener *et al.* 1995 (BC); 19. Choudhury & Dick 1996b (BC, NB, YT)

***Truttaedacnitis* sp.**

Site: ?

Hosts: *Mylocheilus caurinus*; *Prosopium cylindraceum*; *Prosopium williamsoni*; *Rhinichthys cataractae*; *Richardsonius balteatus*; *Salvelinus fontinalis*

Distribution: British Columbia

Record: Bangham & Adams 1954

***Cucullanus* Mueller, 1777**

Synonym: *Indocucullanus* Ali, 1956

Generic diagnosis (after Berland 1970, and Moravec 2013). Cucullanidae. Mouth opening perpendicular to body axis or slightly inclined dorsally, and supported by peribuccal cuticularized frame to which are joined some cuticularized pieces inserted into adjacent oesophageal muscles. Lips and pseudolabia absent. External circle of eight cephalic papillae arranged in incompletely fused pairs; inner circle of six very small papillae near border of mouth opening. Amphids at level of external circle of papillae. Oesophagus undivided, expanded both anteriorly and posteriorly. Intestinal caecum absent. Pre-cloacal sucker of males lacking sclerotized rim. Caudal alae absent. Spicules equal. Gubernaculum present. Vulva near middle of body. Vagina directed anteriorly. Two ovaries. Oviparous, eggs thin-walled.

Key to species of *Cucullanus*

- 1 Males and females over 25 mm long *C. elongatus*
- Males and females less than 21 mm long 2
- 2 Cuticle with prominent transverse annulations anteriorly *C. annulatus*
- Cuticle with only fine transverse striations throughout 3
- 3 Males 5.3–9.2 mm, females 7.5–12.3 mm long; parasites of flatfishes *C. heterochrous*
- Males 9.5–14.7 mm, females 12.9–20.8 mm long; parasites mainly of Gadidae and Merlucciidae *C. cirratus*

***Cucullanus annulatus* Margolis, 1960**

Synonym: *Cucullanus* of Arai (1967 *partim*)

Description (after Margolis 1960). With characteristics of the genus.

Males: slender, 2.21–5.50 mm long, anterior end bent dorsad to varying degrees, and tail curved ventrad. Head

slightly swollen, 0.12–0.18 wide. Body narrows behind head towards mid-oesophageal region then widens again to 0.10–0.25 just behind oesophagus. Body tapers gradually from post-oesophageal region to cloaca and then abruptly

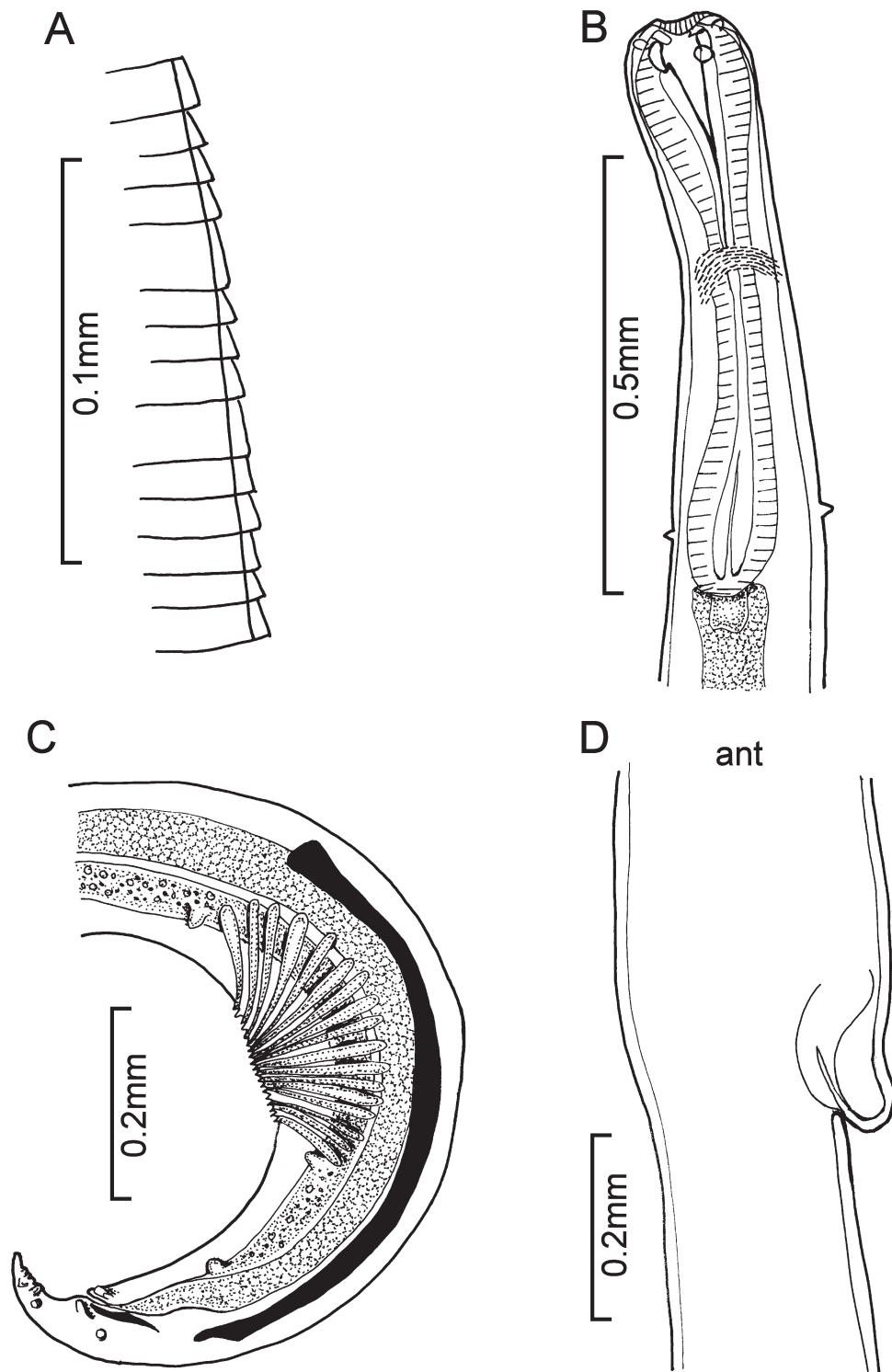


FIGURE 91. *Cucullianus annulatus* Margolis, 1960. A. cuticle of ventral oesophageal region; B. male, anterior end, ventral view; C. male, posterior end, pre-cloacal sucker, lateral view; D. female, vulvar region, lateral view. (Redrawn from Margolis 1960)

to pointed extremity; tail 0.083–0.13 long. Cuticle, 0.002–0.005 thick, appears devoid of transverse striations in posterior half, and very fine striations are barely discernible about mid-length of body, more anteriorly striations become more definite and farther apart; ventrally from a short distance posterior to the oesophago-intestinal

junction to the anterior oesophageal swelling they are more properly termed annulations (Fig. 91A). Attached to cuticular collar surrounding mouth is a continuous membranous flange with many small teeth on internal face. Head with two pairs of cephalic papillae and one pair of lateral amphids. Internally there is a chitinous framework around mouth opening. Oesophagus 0.43–0.70 long, enlarged anteriorly, narrows at midlength then expands again to a swelling less pronounced than the anterior one (Fig. 91B). Two-lobed valve projects from oesophagus into intestine. Intestine opens into short rectum which receives ejaculatory duct to form a cloaca. Nerve ring 0.21–0.30 from anterior end. Lateral cervical papillae 0.026–0.097 anterior to oesophago-intestinal junction. Excretory pore 0.057–0.17 behind oesophagus. Testis originates at about level of anterior margin of pre-cloacal sucker, follows straight course anteriorly then turns back on itself to join seminal vesicle. Pre-cloacal sucker in lateral view appears as fan-shaped group of muscles that when contracted take the form of cup-shaped sucker; it is 0.14–0.29 long and its posterior margin is 0.18–0.37 in front of cloaca. Eleven pairs of caudal papillae. Slender spicules, 0.47–0.76 long, pointed distally and slightly enlarged proximally (Fig. 91C). Gubernaculum 0.065–0.085 long.

Females: egg-bearing specimens 5.16–9.43 long. Dorsal flexure of head not as pronounced as in males. Width at head and posterior end of oesophagus 0.12–0.15 and 0.15–0.21 respectively. Tail pointed, 0.15–0.24 long. Cuticle 0.004–0.008 thick. Cuticular annulations, mouth and associated structures like those of males. Nerve ring 0.28–0.33 from anterior end. Lateral cervical papillae 0.07–0.16 anterior to posterior end of oesophagus. Another pair of lateral papillae occurs about mid-length of the tail. Excretory pore 0.10–0.29 posterior to oesophagus. Vulva, overhung by prominent anterior lip, 3.1–6.1 from anterior end (Fig. 91D). Vagina directed anteriorly joins divergent uteri. Eggs, thin-shelled, 0.072–0.085 x 0.042–0.050.

Site: intestinal lumen

Hosts: *Microstomus pacificus* (4); *Parophrys vetulus* (1, 4); *Platichthys stellatus* (2, 3);

Distribution: Pacific

Records: 1. Margolis 1960; 2. Arai 1967a; 3. Arai 1969; 4. Kabata & Whitaker 1984

***Cucullanus cirratus* Müller, 1777**

Description (after Berland 1970). With characteristics of the genus. Head slightly swollen and bent dorsad, with characteristic two pairs cephalic papillae and one pair amphids. Mouth bordered externally by collarette, bearing on its inner face many (60 to 70) small teeth on each side. Body widest just behind oesophagus. Excretory pore about midway between nerve ring and oesophago-intestinal junction. Deirids about midway between excretory pore and nerve ring (Fig. 92A). Cuticle with fine striations throughout body.

Males: 10.4–14.7 long; maximum width 0.26–0.32. Oesophagus 1.33–1.62 long. Nerve ring 0.474–0.586, deirids 0.744–0.944 and excretory pore 0.960–1.157 from anterior end. Anus to tail tip 0.218–0.296. Cuticle 0.006–0.007 thick. Right spicule 0.915–0.978 long, left one 0.914–1.02 long. Y-shaped gubernaculum 0.160–0.178 long. Pre-cloacal sucker without cuticular rim present. Eleven pairs caudal papillae (Fig. 92B).

Females: 13.1–20.8 long; maximum width 0.29–0.44. Oesophagus 1.47–1.95 long. Nerve ring 0.525–0.653, deirids 0.82–1.08, excretory pore 1.02–1.34 and vulva 7.50–11.72 from anterior end. Anus to tail tip 0.460–0.514. Cuticle 0.005–0.007 thick. Anterior end to vulva 7.50–11.72 (Fig. 92C). Eggs 0.075–0.098 x 0.041–0.052.

Sites: intestinal lumen, stomach

Hosts: *Gadus morhua* (2, 4); *Hippoglossus hippoglossus* (7); *Melanogrammus aeglefinus* (1, 3); *Pollachius virens* (5); *Urophycis tenuis* (6)

Distribution: Atlantic

Records: 1. Kuitunen-Ekbaum 1937b; 2. Gaevskaya & Umnova 1977; 3. Scott 1981; 4. Appy & Burt 1982; 5. Scott 1985; 6. Scott 1987; 7. Scott & Bray 1989

***Cucullanus elongatus* Smedley, 1933**

Synonym: *Cucullanus smedleyi* Campana-Rouget, 1957

Description (after Berland 1983). With characteristics of the genus. Body exceptionally long for a cucullanid, up to

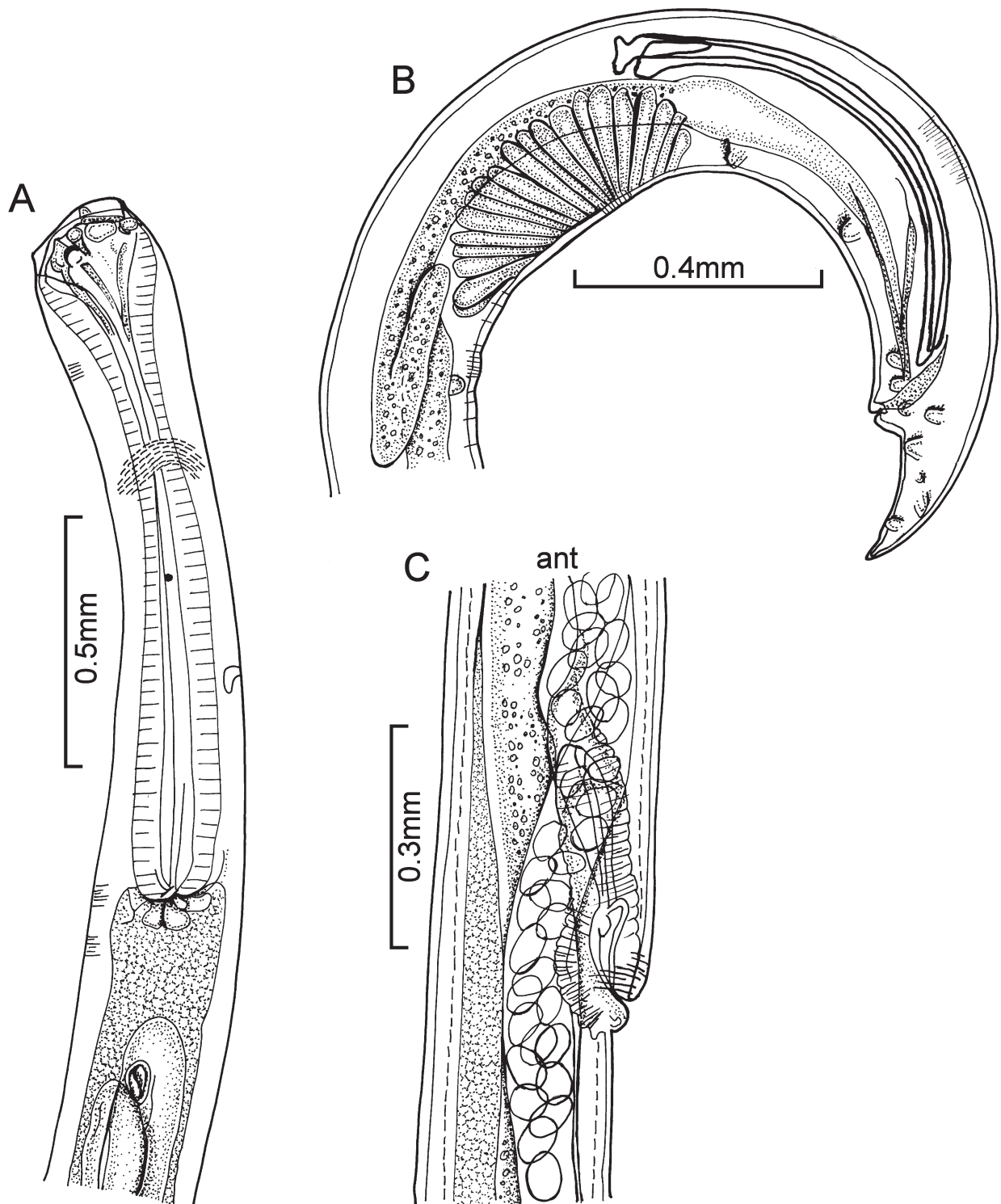


FIGURE 92. *Cucullanus cirratus* Müller, 1777. A. anterior end, lateral view; B. male, posterior end, lateral view; C. female, vulvar region. (Redrawn from Berland 1970)

over 30 in males, and 40 in females. Head rounded, slit-like mouth opening shifted slightly to dorsal side. Double club-shaped oesophagus. Narrow isthmus between anterior and posterior swollen portions of oesophagus surrounded by nerve ring. Excretory pore between nerve ring and intestine. Cuticle thin in anterior body, increasing to about 0.007 at mid-body, and to about 0.010 near anus. Cuticular striations relatively fine throughout. Pair of lateral deirids at about level of mid-oesophagus, and pair of lateral papillae near mid-body (Fig. 93A). Mouth opening oval, surrounded by collarette, provided on inner face with about 60 short triangular teeth on each side.

Two pairs of large cephalic papillae and one pair lateral amphids external to collarette. Raised, smooth, tubular peribuccal rim lying internal to collarette. Posterior to peribuccal rim on each side a large, bilobed, rounded structure (“peribuccal tooth”) projects into pseudobuccal capsule. Cuticular lining of oesophagus and pseudobuccal capsule complex, with cuticular structures extending into surrounding muscles. Tail simple and conical, tapering evenly to a point.

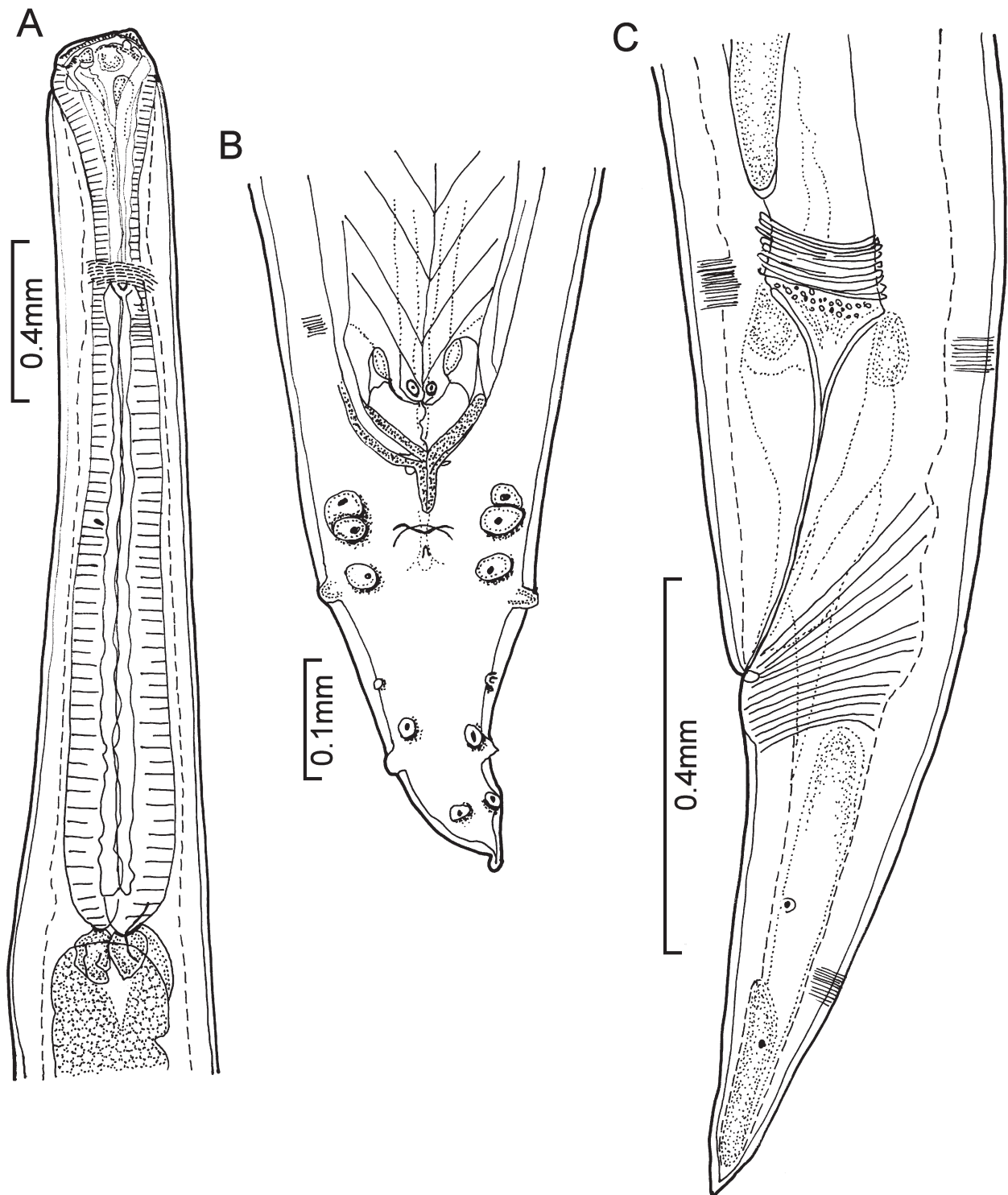


FIGURE 93. *Cucullanus elongatus* Smedley, 1933. A. anterior end, lateral view; B. male, posterior end, ventral view; C. female, posterior end, lateral view. (Redrawn from Berland 1983)

Males: 25.54–30.90 long, tapering posteriorly but widening at pre-cloacal sucker; maximum width 0.33–0.40. Oesophagus 1.96–2.32 long. Nerve ring 0.53–0.60, deirids 1.18–1.44 and excretory pore 1.59–1.79 from anterior end. Small spine on post-cloacal wall. Testis single, in anterior body, a loop extends forward to some distance posterior to oesophagus. Left spicule 1.19–1.45, and right spicule 1.19–1.52 long. Gubernaculum 0.064–0.101 long. Proximal cavity or sac ventral to gubernacular limbs, Y-shaped in ventral view. Ten pairs caudal papillae: five pairs pre-cloacal, five pairs post-cloacal. One pair small phasmids (Fig. 93B).

Females: 38.41–43.25 long; maximum width 0.47–0.54. Oesophagus 2.21–2.51 long. Nerve ring 0.60–0.63, deirids 1.29–1.48, excretory pore 1.64–2.05 and vulva 21.38–24.74 from anterior end. Phasmids at about mid-length of long tapering tail (Fig. 93C). Eggs 0.082–0.099 x 0.040–0.047.

Site: intestinal lumen

Hosts: *Ophiodon elongatus* (1, 2, 5); *Sebastes caurinus* (3, 4); *Sebastes maliger* (4); *Sebastes nebulosus* (6); *Sebastes ruberrimus* (4)

Distribution: Pacific

Records: 1. Smedley 1933; 2. Margolis 1952b; 3. Arai 1969; 4. Sekerak & Arai 1977; 5. Berland 1983; 6. Holmes 1990

***Cucullanus heterochrous* Rudolphi, 1802**

Description (after Berland 1970). With characteristics of the genus. Body fairly stout and of even breadth, greatest width just behind oesophagus. Head straight or slightly bent dorsally, and only slightly swollen. Cuticle transversely striated throughout, 0.003–0.007 thick. Mouth a dorso-ventral slit. Collarette surrounding the mouth well developed, the inner face with about 50 teeth on either side. Characteristic two pairs large papillae and one pair amphids on head. Internal circle of six relatively large papillae. Dorsal half of pseudobuccal capsule wide. Peribuccal rim lies well within mouth opening. Oesophagus relatively short, straight at nerve ring level but slightly dilated just behind it (Fig. 94A).

Males: 5.33–7.55 long; maximum width 0.17–0.22. Oesophagus 0.77–0.94 long. Nerve ring 0.31–0.38, deirids 0.69–0.75 and excretory pore 0.91–1.08 from anterior end. Pre-cloacal sucker present. Left spicule 0.78–1.08 long, right spicule 0.71–0.97 long; one spicule, usually the left one, has a screw-like tip, whilst the other is usually straight and more blunt. Both spicules carry broad alae. Gubernaculum 0.046–0.059 long. Pointed tail narrows abruptly behind cloaca. In addition to the usual 11 pairs of caudal papillae there is one large median papilla behind the cloaca (Fig. 94B).

Females: 7.50–10.78 long; maximum width 0.21–0.29. Oesophagus 0.93–1.03 long. Nerve ring 0.37–0.42, deirids 0.82–0.96, excretory pore 1.11–1.19 and vulva 4.56–6.50 from anterior end. Protrusion (“post-cloacal lip”) behind anus (Fig. 94C). Eggs 0.072–0.091 x 0.042–0.049.

Site: alimentary tract

Hosts: *Hippoglossus stenolepis* (2, 3); *Limanda ferrugineus* (1); *Pseudopleuronectes americanus* (1)

Distribution: Atlantic, Pacific

Records: 1. Ronald 1963 (AT); 2. Blaycock 1996 (PA); 3. Blaycock *et al.* 1998a (PA)

***Cucullanus* sp.**

Site: intestinal lumen

Hosts: *Cymatogaster aggregata* (2, 4, 5); *Fundulus diaphanus* (6); *Oncorhynchus kisutch* (5); *Parophrys vetulus* (1); *Perca flavescens* (8); *Platichthys stellatus* (3); *Paraplagusia bilineata* (3, 5); *Ronquilus jordani* (3, 5); *Sebastes aleutianus* (7); *Sebastes alutus* (7); *Sebastes babcocki* (7); *Sebastes borealis* (7); *Sebastes crameri* (7); *Sebastes flavidus* (7); *Sebastes paucispinis* (7); *Sebastes ruberrimus* (7)

Distribution: Atlantic, Ontario, Pacific

Records: 1. Margolis 1952a (PA); 2. Arai 1964 (PA); 3. Arai 1967a (PA); 4. Arai 1967b (PA); 5. Arai 1969 (PA); 6. Wiles 1975 (AT); 7. Sekerak & Arai 1977 (PA); 8. Anthony 1978b (ON)

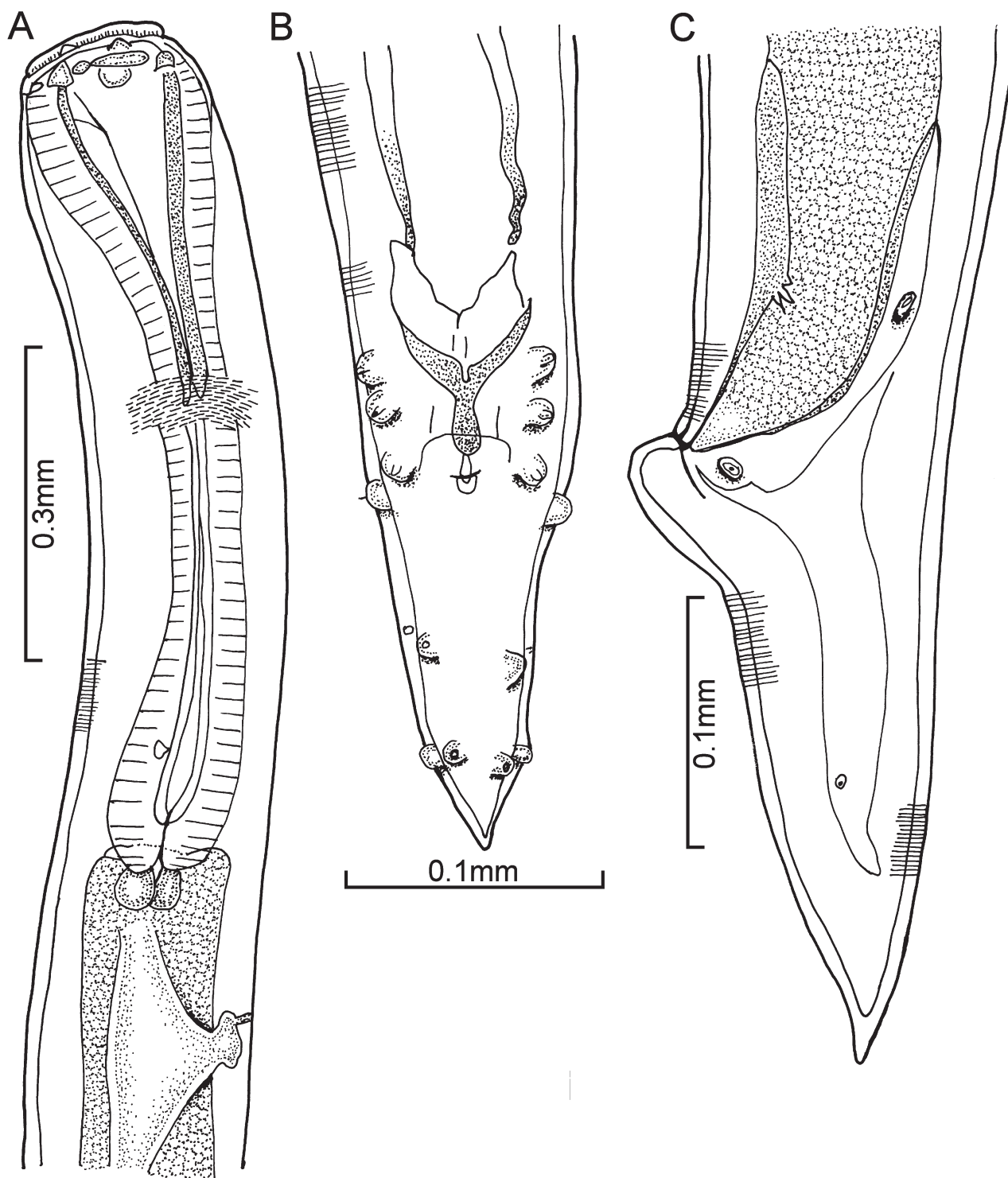


FIGURE 94. *Cucullanus heterochrous* Rudolphi, 1802. A. anterior end, lateral view; B. male, tail, ventral view; C. female, tail, lateral view. (Redrawn from Berland 1970)

Dichelyne Jägerskiöld, 1902

Generic diagnosis (after Moravec 2013). Cucullanidae. Mouth opening perpendicular to body axis. Pseudobuccal capsule laterally narrowed. Three small papillae on either side of mouth opening. Oesophagus simple, undivided. Dorsal intestinal caecum present. Pre-cloacal sucker absent. Spicules equal and similar. Gubernaculum present. Vulva behind middle of body. Two ovaries. Oviparous.

One species, *D. robustus*, is known from two species of *Ameiurus* in Canada.

***Dichelyne robustus* (Van Cleave & Mueller, 1932) Mueller, 1933**

Synonym: *Dacnitoides robusta* Van Cleave & Mueller, 1932

Description (after Van Cleave & Mueller 1932). With characteristics of the genus. Body robust, with conspicuous cuticular thickening from oral region to beyond limit of oesophagus. Prominent pair of amphids or cephalic papillae near posterior limit of oesophagus. Oesophagus 0.38–0.43 long. Ventral intestinal caecum extends anteriorly almost to buccal cavity (Fig. 95A).

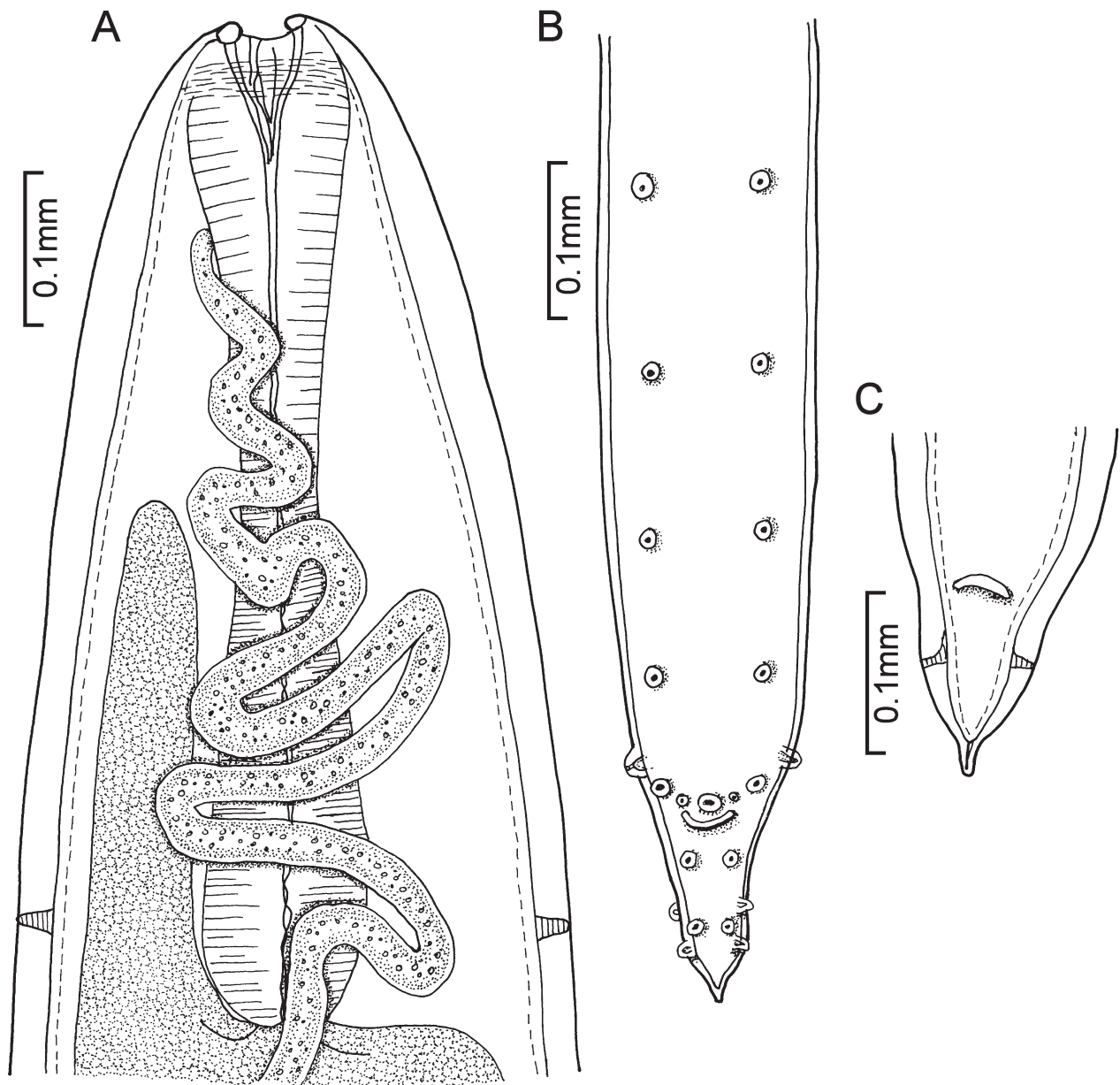


FIGURE 95. *Dichelyne robustus* (Van Cleave & Mueller, 1932) Mueller, 1933. A. female, anterior end, dorsal view; B. male, posterior end, ventral view; C. female, tail, ventral view. (Redrawn from Van Cleave & Mueller 1932)

Males: 4.25–4.50 long; width about 0.32. Pre-cloacal sucker absent. Four pairs of pre-cloacal and four pairs of post-cloacal papillae. One median and three pairs of lateral papillae just anterior to cloaca (Fig. 95B). Spicules relatively short; when withdrawn they appear tubular but when extruded are broad, ribbon-like, with frilled tips. Gubernaculum apparently absent.

Females: about 5.0 long; width 0.47–0.51. Ovarian coils extend almost to anterior end of body (Fig. 93A). Vulva short distance behind mid-body. Anus about 0.15 from tail tip. Pair minute lateral papillae in middle of post-cloacal region. Tail bears spine with “the structure of a sensory papilla” (Fig. 95C).

Comments: the original description of *D. robustus* is inadequate and, according to Caspeta-Mandujano *et al.* (1999), type specimens are not available in the US National Parasite Collection, Beltsville, Maryland—collections that have been transferred to the Smithsonian Institution, National Museum of Natural History (Washington, DC, USA). It seems that Maggenti (1971) was not first to transfer *Dacnitoides robusta* to *Dichelyne* as “*Dichelyne robusta*” [= *Dichelyne robustus*]. The *n.comb.* appears to have been first proposed by Mueller (1933).

Site: intestinal lumen

Hosts: *Ameiurus melas* (2); *Ameiurus nebulosus* (1)

Distribution: Manitoba, Ontario

Records: 1. Bangham 1955 (ON); 2. Choudhury & Nadler 2016 (MB)

***Dichelyne* sp.**

Site: ?

Host: *Etheostoma nigrum*

Distribution: Ontario

Record: Bangham 1955

***Cucullanellus* Törnquist, 1931**

Generic diagnosis (after Bykhovskaya-Pavlovskaya *et al.* 1964). Cucullanidae. Anterior end of body not inflated or only slightly so. Lateral alae absent. Mouth opening transverse to body axis or slightly inclined dorsally. Pseudobuccal capsule a laterally compressed slit. Three small papillae on each side of mouth opening. Oesophagus expanded at both ends. Ventral intestinal caecum present. Males with pre-cloacal sucker. First three pairs of caudal papillae distributed anteriorly. Spicules equal or nearly so. Gubernaculum present. Vulva behind mid-body.

Key to species of *Cucullanellus*

- | | | |
|---|---|-----------------------|
| 1 | Cuticle 0.020–0.050 thick; mouth opening slightly inclined dorsally | <i>C. cotylophora</i> |
| - | Cuticle thinner than 0.020; mouth opening transverse to body axis | 2 |
| 2 | Ventral intestinal caecum not reaching nerve ring | <i>C. kanabus</i> |
| - | Ventral intestinal caecum reaches nerve ring, its apex sometimes double | <i>C. minutus</i> |

***Cucullanellus cotylophora* (Ward & Magath, 1917) Petter, 1974**

Synonyms: *Dacnitoides cotylophora* Ward & Magath, 1917; *Dichelyne cotylophora* (Ward & Magath, 1917) Gendre 1927 (?1928)

Description (after Baker 1984). With characteristics of the genus. Body robust. Cuticle relatively thick, 0.020–0.050 near mid-body, with faint irregularly spaced striations. Mouth opening slightly inclined dorsally, dorso-ventrally elongated in large specimens, surrounded by raised collarette with rib-like thickenings. Six small inner labial papillae, and four outer double cephalic papillae present. Cheilostome absent. In large worms (> 5 mm long), oesophastome well developed, consisting of anterior dorso-ventrally elongate ring forming the mouth and extending posteriorly in a funnel-shaped triradiate structure lining the lumen of anterior third of oesophagus; three lobes of funnel portion with sharp processes on outer edges

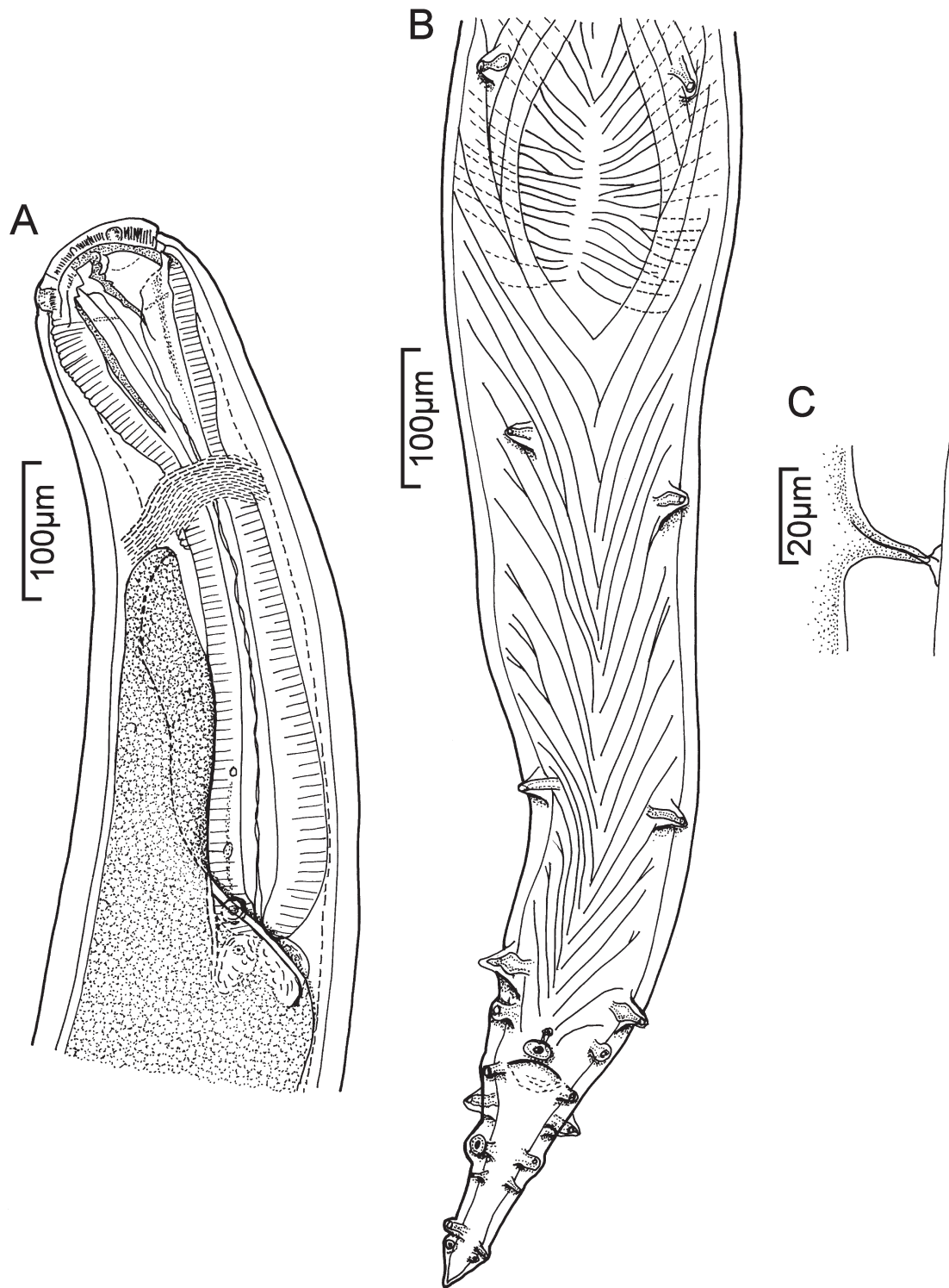


FIGURE 96. *Cucullanellus cotylophora* (Ward & Magath, 1917) Petter, 1974. A. large male [> 5 mm long], anterior end, lateral view; B. large male, posterior end, ventral view; C. phasmid of gravid female, dorsal view. (Redrawn from Baker 1984a)

extending into oesophageal musculature; ventral edge of oesophastomal ring with short bilobed process extending on top of adjacent oesophageal tissue; dorso-lateral edges of ring with pair of blindly ending, wide, flat cuticular processes extending posteriorly over exterior surface of oesophagus; lateral edges of ring with pair of blindly ending elongate processes extending posteriorly over surface of oesophagus and connected to lining of oesophageal lumen by thin cuticular connective running through oesophagus. In small worms (< 2 mm long)

oesophastom relatively weakly sclerotized, oesophastomal ring more ovoid in apical view than in larger worms; dorso-lateral and lateral pairs of blindly ending processes on ring relatively short and undeveloped; lumen of oesophastom relatively thin. Oesophagus wide at anterior and posterior ends. Excretory pore posterior to oesophagus. Ventral intestinal caecum well developed in large worms, extending anterior to oesophagus; less well developed in small worms (Fig. 96A). Anterior pair of digitiform deirids near posterior end of oesophagus; another pair deirid-like digitiform papillae just posterior to mid-body.

Males: 1.14–6.48 long. Oesophagus 0.212–0.567 long. Nerve ring 0.084–0.208, and excretory pore 0.253–0.824 from anterior end. Tail 0.078–0.151, spicules 0.233–1.024, and gubernaculum 0.050–0.098 long. Ten pairs and one unpaired caudal papillae present (Fig. 96B): tail with one lateral pair, two subventral pairs, and one subdorsal pair; area adjacent to and just anterior to cloaca with three pairs closely spaced subventral papillae and one unpaired papilla on cloacal lip; pre-cloacal region with three pairs subventral papillae distributed relatively anteriorly. Large pair lateral phasmids near middle of tail. Large mature males with 18 pairs muscle cells extending to large protruding pre-cloacal sucker. Small males have poorly developed sucker, not protruding. Spicules of large worms heavily sclerotized with lateral alae in medial portion; in small worms spicules weakly sclerotized, alae not differentiated. Gubernaculum heavily sclerotized in large worms. Testis relatively undifferentiated in small worms, not patent with developing *vas deferens*. Testis connected to *vas deferens* when worms 2.2 long; sexual maturity seen at 3.5 long.

Females: 1.19–7.17 long. Oesophagus 0.221–0.655 long. Nerve ring 0.074–0.229, excretory pore 0.291–0.914, and vulva 0.075–4.47 from anterior end. Tail 0.086–0.191 long, conical with pair large lateral phasmids near middle (Fig. 96C). Amphidelphic, each uterus with up to 100 eggs at 1–4 cell stage. Eggs 0.070–0.073 x 0.047–0.055.

Site: intestinal lumen

Hosts: *Ambloplites rupestris* (6); *Ameiurus melas* (2); *Ameiurus nebulosus* (3); *Aplodinotus grunniens* (2, 13); Centrarchidae gen. sp. (17); *Esox americanus vermiculatus* (2); *Lepomis gibbosus* (19); *Lepomis macrochirus* (2); *Lota lota* (10, 18); *Luxilus cornutus* (16); *Micropterus dolomieu* (2, 6, 19, 21); *Micropterus salmoides* (2, 6); *Morone americana* (9, 19); *Morone chrysops* (2, 14); *Perca flavescens* (1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 15, 16, 19, 20, 21, 22, 23); *Sander vitreus* (2, 6, 19)

Distribution: Manitoba, Ontario, Quebec

Records: 1. Smedley 1934 (ON); 2. Bangham & Hunter 1939 (ON); 3. Bangham 1941 (ON); 4. Bangham & Venard 1946 (ON); 5. Worley & Bangham 1952 (QC); 6. Bangham 1955 (ON); 7. Tedla 1969 (ON); 8. Tedla & Fernando 1969a (ON); 9. Tedla & Fernando 1969b (ON); 10. Dechtiar 1972a (ON); 11. Tedla & Fernando 1972 (ON); 12. Cannon 1973 (ON); 13. Anthony 1982 (ON); 14. Anthony 1984 (ON); 15. Baker 1984a (ON); 16. Baker 1984b (ON); 17. Anthony 1985 (ON); 18. Anthony 1987 (ON); 19. Dechtiar & Christie 1988 (ON); 20. Dechtiar & Lawrie 1988 (ON); 21. Dechtiar & Nepszy 1988 (ON); 22. Dechtiar *et al.* 1988 (ON); 23. Choudhury & Dick 1996b (MB)

***Cucullanellus kanabus* Walder & Arai, 1974**

Synonym: *Cucullanus* sp. of Arai (1967, 1969 *partim*)

Description (after Walder & Arai 1974). With characteristics of the genus. Relatively slender worms, head not enlarged. Cuticle 0.002–0.009 thick, with fine striae visible only in larger worms. Mouth a dorso-ventral slit, transverse to body axis, surrounded by short collarete bearing many small teeth. Two lateral amphids and 4 submedian cephalic papillae present. Oesophagus with sclerotized lining, dilated anteriorly as a laterally compressed pseudobuccal capsule. Dorsally, capsule lining produced into lateral plates appearing in dorsal view as a pair of anterior horn-shaped structures and a pair of broad, blade-like structures tapering posteriorly and extending almost to nerve ring level. Anterior portion of capsule a thickened sclerotized rim with short angular block ventrally. Oesophago-intestinal valve consisting of two lateral lobes. Ventral intestinal caecum not reaching nerve ring (Fig. 97A). Both sexes with tapering tail.

Males: 3.05–7.48 long maximum width 0.084–0.20. Posterior end curved ventrally, tail 0.065–0.11 long. Oesophagus 0.47–0.71, and ventral intestinal caecum 0.14–0.37 long. Nerve ring 0.14–0.27 from anterior end.

Excretory pore 0.030–0.48 [sic] behind oesophagus (Fig. 97A). Cervical papillae anterior or posterior to posterior end of oesophagus. Two lateral papillae in mid-body region. Posterior margin of pre-cloacal sucker 0.23–0.48 from anus. Testis not convoluted, origin near level of, or posterior to, sucker, anterior extent 0.14–2.25 from oesophagus. Spicules slender, pointed, virtually equal at 0.33–0.60 (left) and 0.32–0.61 (right) long (Fig. 97B). Gubernaculum 0.034–0.059 long. Eleven pairs caudal papillae: three pairs pre-cloacal, subventral, distributed relatively anteriorly; four pairs ad-cloacal; four pairs post-cloacal near tip of tail (Fig. 97B).

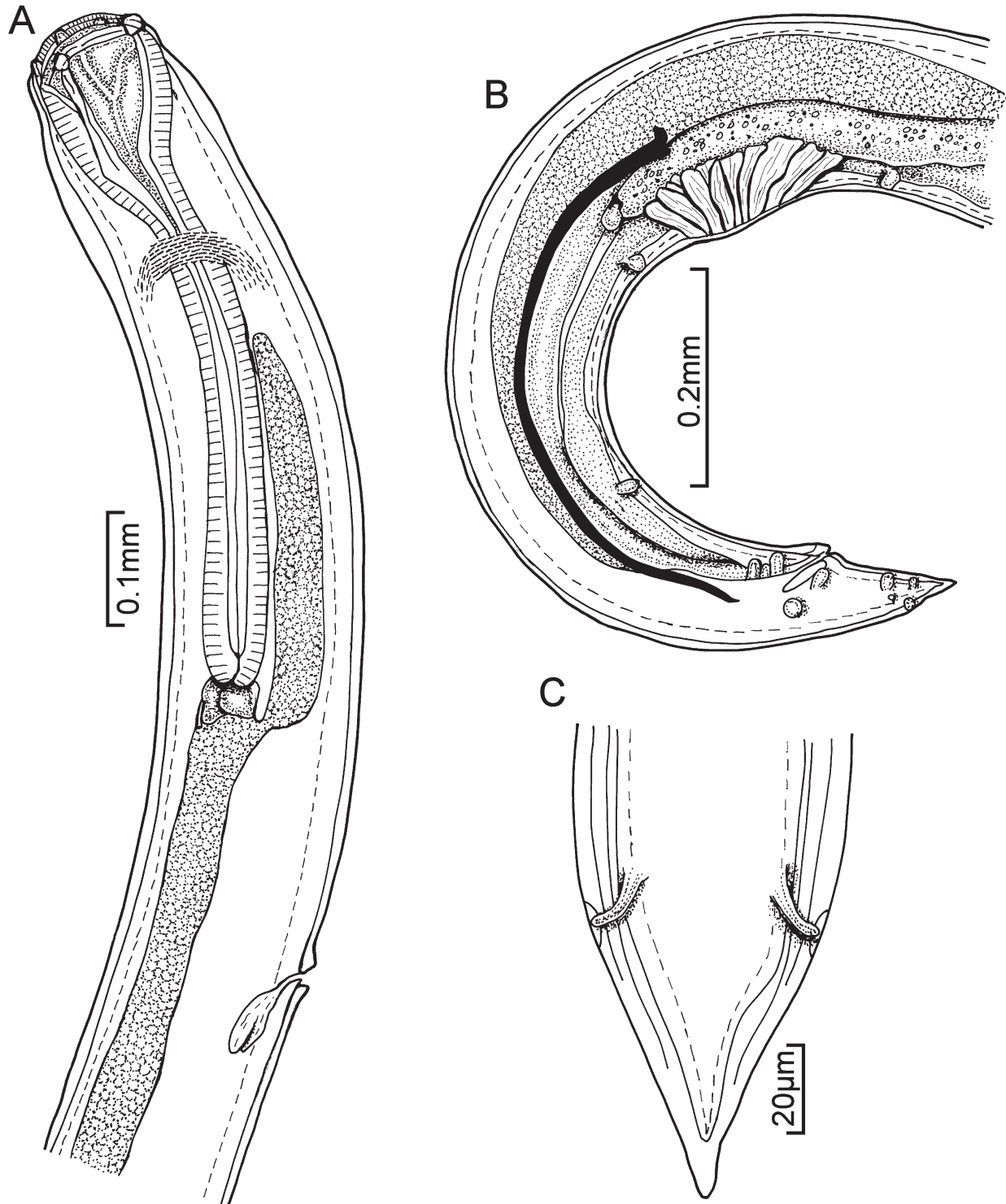


FIGURE 97. *Cucullanellus kanabus* Walder & Arai, 1974. A. male, anterior end, lateral view; B. male, posterior end, lateral view; C. female, posterior end, ventral view. (Redrawn from Walder & Arai 1974)

Females: 4.99–10.61 long; maximum width 0.12–0.27. Oesophagus 0.57–0.77, and ventral intestinal caecum 0.17–0.42 long. Nerve ring 0.22–0.27 from anterior end. Excretory pore 0.13–0.46 behind posterior end of oesophagus. Cervical and lateral papillae as in males. One pair lateral phasmids, not papillose, about one-third distance from posterior end to anus (Fig. 97C). Vulva in posterior half of body, 3.26–6.11 from anterior end. Vagina directed anteriorly, amphidelphic. Ovaries convoluted, anterior one extending to near oesophagus, posterior one to near anus. Eggs 0.059–0.074 x 0.034–0.058.

Site: intestinal lumen

Host: *Cymatogaster aggregata*

Distribution: Pacific

Records: Arai 1967b; Walder & Arai 1974; Arai & Arthur 1977; Arai *et al.* 1988

***Cucullanellus minutus* (Rudolphi, 1819) Törnquist, 1931**

Description (after Berland 1970). With characteristics of the genus. Worms broad relative to their length, widest

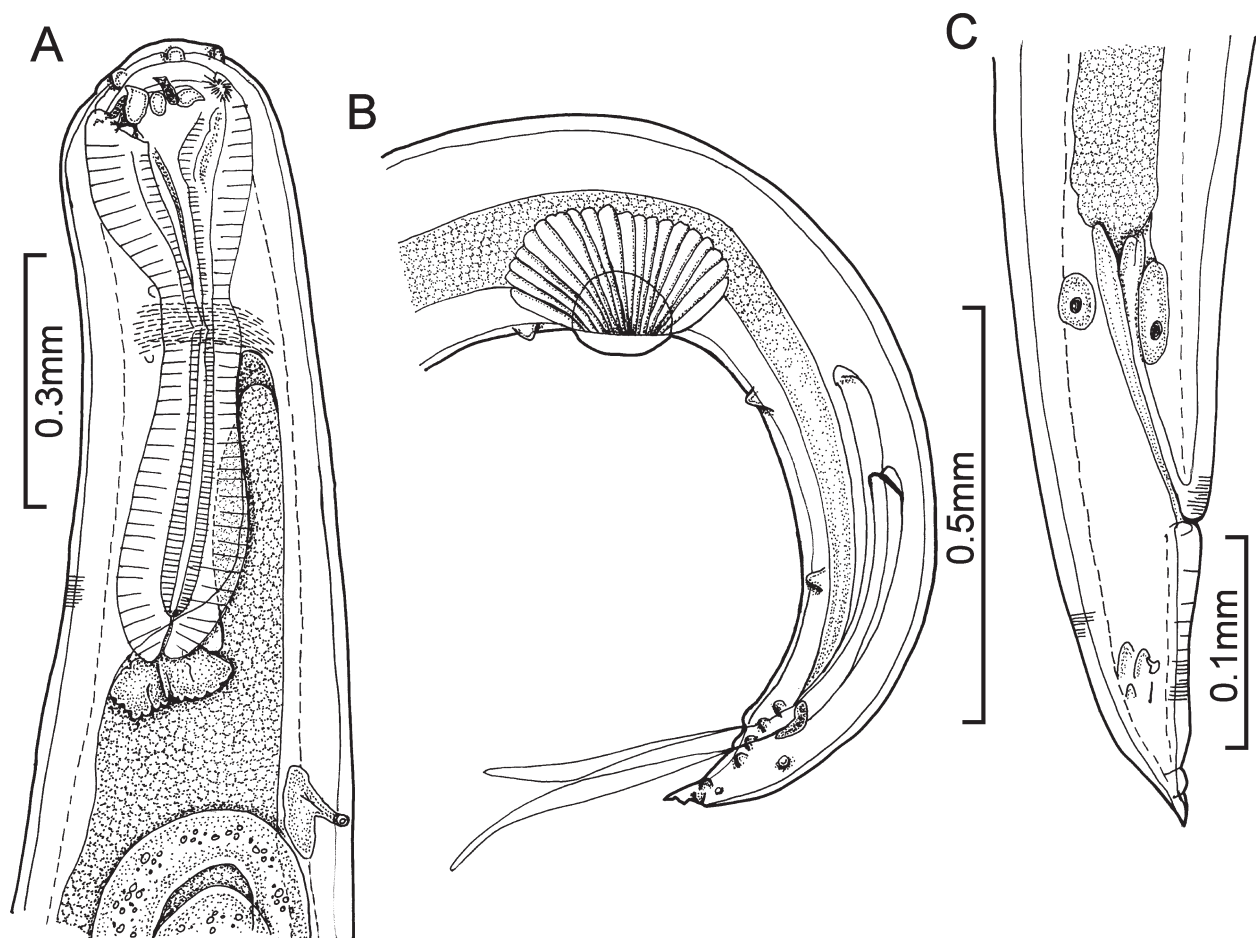


FIGURE 98. *Cucullanellus minutus* Törnquist, 1931. A. anterior end, lateral view; B. male, posterior end, lateral view; C. female, posterior end, lateral view. (Redrawn from Berland 1970)

about the mid-body. Cuticle 0.010–0.020 thick, with fine transverse striae. Head rounded, not dilated, with two pairs large cephalic papillae and one pair amphids. Internal circle of six very small papillae. Mouth a dorso-ventral slit, transverse to body axis, with well developed collarette bearing many (70–80) relatively long, narrow teeth on each side. Simple pseudobuccal capsule, laterally compressed. Peribuccal rim lies well within capsule, and from which several cuticular structures extend into surrounding muscle mass. Ventral intestinal caecum may reach as far anteriorly as nerve ring, its apex sometimes double (Fig. 98A).

Males: 3.70–4.60 long; maximum width 0.36–0.44. Tail curved ventrally. Oesophagus 0.612–0.695 long.

Nerve ring 0.260–0.280, deirids 0.545–0.680, and excretory pore 0.655–0.860 from anterior end. Anus to conical tail 0.123–0.148. Conspicuous pre-cloacal sucker, with rim. Spicules virtually equal, 0.800–0.895 (left) and 0.730–0.895 (right) long. Y-shaped gubernaculum about 0.050 long. Eleven pairs caudal papillae with a distribution similar to that of *C. cotylophora* and *C. kanabus* (Fig. 98B).

Females: 3.42–4.90 long; maximum width 0.52–0.62. Oesophagus 0.657–0.710 long. Nerve ring 0.275–0.297, deirids 0.465–0.763, excretory pore 0.534–0.890 and vulva 2.05–3.10 from anterior end. Pair small lateral papillae about midway between anus and tip of conical tail (Fig. 98C). Eggs 0.068–0.081 x 0.044–0.055.

Site: intestinal lumen

Host: *Tautogolabrus adspersus*

Distribution: Atlantic

Record: Sekhar S. [sic] & Threlfall 1970

Family QUIMPERIIDAE (Gendre, 1928 [?1927]) Baylis, 1930

Subfamily QUIMPERIINAE Gendre, 1928 [?1927]

Intestinal caecum absent. Buccal cavity small or absent. Gubernaculum small or absent. Pre-cloacal sucker absent or weakly developed. Anterior part of body with large lateral alae. Deirids large.

Key to the two genera of QUIMPERIINAE known from Canadian fishes

- 1 Oblique muscle bands in pre-cloacal region of male absent; lips absent; oesophagus without pharynx and without teeth protruding into buccal cavity *Haplonema*
- Distinct oblique muscle bands in pre-cloacal region of male present; mouth opening surrounded by three small lips; oesophagus with distinct pharyngeal portion and teeth protruding into buccal cavity *Paraquimperia*

Haplonema Ward & Magath, 1917

Generic diagnosis (after Arthur & Margolis 1975). Quimperiidae. Medium-sized worms with anterior end bent dorsally: head with four single or double submedian papillae and two lateral amphids; mouth without lips, opening directly into oesophagus; oesophagus muscular throughout, divided at nerve ring level into two sections, the posterior of greater width than anterior; lateral alae and deirids present. Excretory pore anterior or posterior to oesophago-intestinal junction. Males with caudal papillae present or absent; posterior end strongly curved ventrad; 10 or 11 pairs of caudal papillae, five pairs pre-cloacal, one pair ad-cloacal, four or five pairs post-cloacal; one median pre-cloacal papilla present or absent; spicules equal, gubernaculum present. Females with straight posterior end, vulva slightly behind middle of body; amphidelphic; eggs oval, smooth-shelled, unsegmented or two-celled stage *in utero*.

Key to species of *Haplonema*

- 1 Head with four submedian double papillae, two lateral amphids, and six radially arranged ridges; males with 11 pairs caudal papillae and one unpaired median pre-cloacal papilla; vulva protruding beyond body wall *H. hamulatum*
- Head with four submedian single papillae, and two lateral amphids, lacking radially arranged ridges; males with 10 pairs caudal papillae, lacking an unpaired papilla; vulva not protruding beyond body wall *H. immutatum*

Haplonema hamulatum Moulton, 1932

Description (after Arthur & Margolis 1975). With characteristics of the genus. [Two sets of measurement are given, the first for syntypes, the second in parentheses for material collected subsequently.]

Males: syntypes length not available (8.31–11.76); maximum width 0.20 (0.14–0.20). Cuticular striations very

fine. Head with four submedian double papillae, two lateral amphids, and six radially arranged ridges, one extending from each of the papillae and amphids to rim of mouth. Lips and buccal capsule absent, mouth opening directly into oesophagus, 0.512 (0.595–0.890) long. Nerve ring 0.248 (0.312–0.383) from anterior end. Excretory pore slightly posterior to oesophago-intestinal junction, distance from anterior end not available for syntypes (0.717–1.036). Lateral alae extending 1.03 (0.828–1.840) posteriorly from anterior end. Digitate deirids anterior to oesophago-intestinal junction, 0.392 (0.450–0.754) from anterior end (Fig. 99A). Testis originating a little anterior to anus and extending anteriorly beyond mid-body before doubling back to proceed posteriorly and join seminal vesicle. Spicules short, about equal: left one 0.130–0.151 (0.118–0.157), right one 0.130–0.150 (0.104–0.156) long. Gubernaculum wedge-shaped, 0.036–0.041 (0.027–0.045) long. Eleven pairs caudal papillae and one unpaired median pre-cloacal papilla. Phasmids not observed. Caudal alae present, extending from tip of tail to slightly anterior to 1st pair caudal papillae. Tail attenuated, 0.214–0.229 (0.156–0.230) long (Fig. 99B).

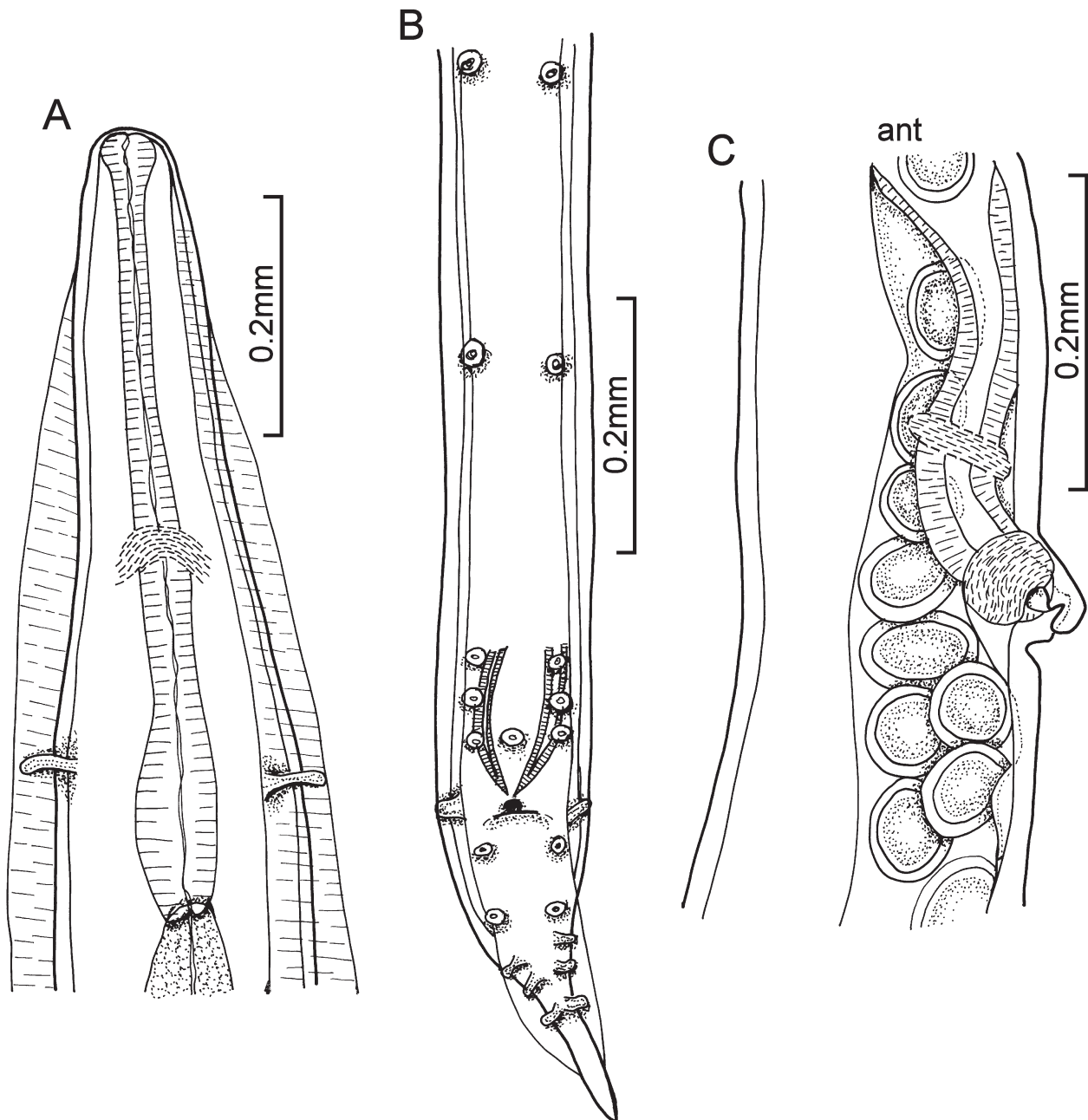


FIGURE 99. *Haplonema hamulatum* Moulton, 1932. A. female, anterior end, ventral view; B. male, posterior end, ventral view; C. female, vulvar region, lateral view. (Redrawn from Arthur & Margolis 1975)

Females: 9.50–9.91 (9.51–10.88) long; maximum width 0.22–0.28 (0.16–0.18). Head and oesophagus structure and cuticular striations as in males. Oesophagus 0.602–0.615 (0.628–0.709) long. Nerve ring 0.325–0.461 (0.310–0.372) from anterior end. Lateral alae extending posteriorly 1.03–1.84 (1.43–1.69) from anterior end. Deirids 0.511–0.523 (0.486–0.582) from anterior end. Excretory pore a little posterior to oesophago-intestinal junction, 0.692–0.794 from anterior end. Vulva prominent, protruding beyond body wall and guarded by two digitate lateral projections, 5.42–5.79 (5.97–6.67) from anterior end (Fig. 99C). Muscular vagina directed anteriorly, 0.177–0.186 (0.195–0.266) long. Uteri amphidelphic. Eggs 0.065–0.077 x 0.043–0.051 (0.050–0.072 x 0.047–0.058). Tail 0.457–0.486 (0.0470–0.538) long. Phasmids not observed.

Site: intestinal lumen

Hosts: *Lota lota* (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14); *Oncorhynchus mykiss* (8, 11); *Prosopium williamsoni* (8, 11); *Salvelinus malma* (8, 11)

Distribution: Alberta, British Columbia, Ontario, Yukon Territory

Records: 1. Moulton 1932 (ON); 2. Bangham & Hunter 1939 (ON); 3. Bangham 1941 (ON); 4. Bangham & Venard 1946 (ON); 5. Bangham 1955 (ON); 6. Arthur & Margolis 1975 (YT); 7. Arthur *et al.* 1976 (YT); 8. Anon. 1978 (BC); 9. Anon. 1981 (BC); 10. Leong & Holmes 1981 (AB); 11. Arai & Mudry 1983 (BC); 12. Anon. 1984 (BC); 13. Dechtiar & Lawrie 1988 (ON); 14. Dechtiar *et al.* 1988 (ON)

***Haplonema immutatum* Ward & Magath, 1917**

Description (after Arthur & Margolis 1975). With characteristics of the genus.

Males: 11.82–15.50 (10.40–11.64) long; maximum width 0.21–0.27 (0.25–0.28). Cuticle striated. Head with four submedian single papillae and two lateral amphids. Lips absent, mouth opening directly into oesophagus, 0.673–0.828 (0.724–0.811) long. Nerve ring 0.301–0.361 (0.304–0.336) from anterior end. Excretory pore slightly anterior to oesophago-intestinal junction. 0.723 in one syntype (0.680–0.689) from anterior end. Lateral alae extending from anterior end to level of 1st pair caudal papillae. Digitate deirids anterior to oesophago-intestinal junction, 0.504–0.616 (0.483–0.525) from anterior end (Fig. 100A). Testis origin as in *H. hamulatum* (see above). Spicules long, slender, about equal: left one 0.584–0.747 (0.740–0.756), right one 0.573–0.712 (0.738–0.758) long. Gubernaculum small, curved ventrally, 0.051–0.054 (0.050–0.054) long. Ten pairs caudal papillae (Fig. 100B). Phasmids not observed. Caudal alae absent. Tail 0.164–0.201 (0.195–0.208) long.

Females: 13.29–15.57 (11.69–14.74) long. Head and oesophagus structure and cuticular striations as in males. Oesophagus 0.678–0.805 (0.680–0.856) long. Nerve ring 0.320–0.369 (0.286–0.3740) from anterior end. Excretory pore slightly anterior to oesophago-intestinal junction, 0.515 in one syntype (0.585–0.763) from anterior end. Lateral alae extending from anterior end to slightly anterior to anus. Digitate deirids slightly anterior to oesophago-intestinal junction, 0.565–0.577 (0.425–0.569) from anterior end. Vulva in posterior half of body, 8.61–9.81 (7.19–9.48) from anterior end (Fig. 100C). Muscular vagina directed anteriorly, 0.230–0.268 (0.212–0.336) long. Uteri amphidelphic. Eggs 0.052–0.069 x 0.039–0.052 (0.044–0.064 x 0.034–0.045). Tail 0.221–0.297 (0.209–0.253) long. Phasmids distinct, anterior to mid-length of tail.

Site: intestinal lumen

Host: *Amia calva*

Distribution: Ontario

Records: Bangham & Hunter 1939; Bangham 1955

***Haplonema* sp.**

Site: intestinal lumen

Hosts: *Cottus cognatus* (1); *Lota lota* (2, 3)

Distribution: Alberta, British Columbia, Labrador

Records: 1. Bangham & Adams 1954 (BC); 2. Threlfall & Hanek 1971 (LB); 3. Leong 1975 (AB)

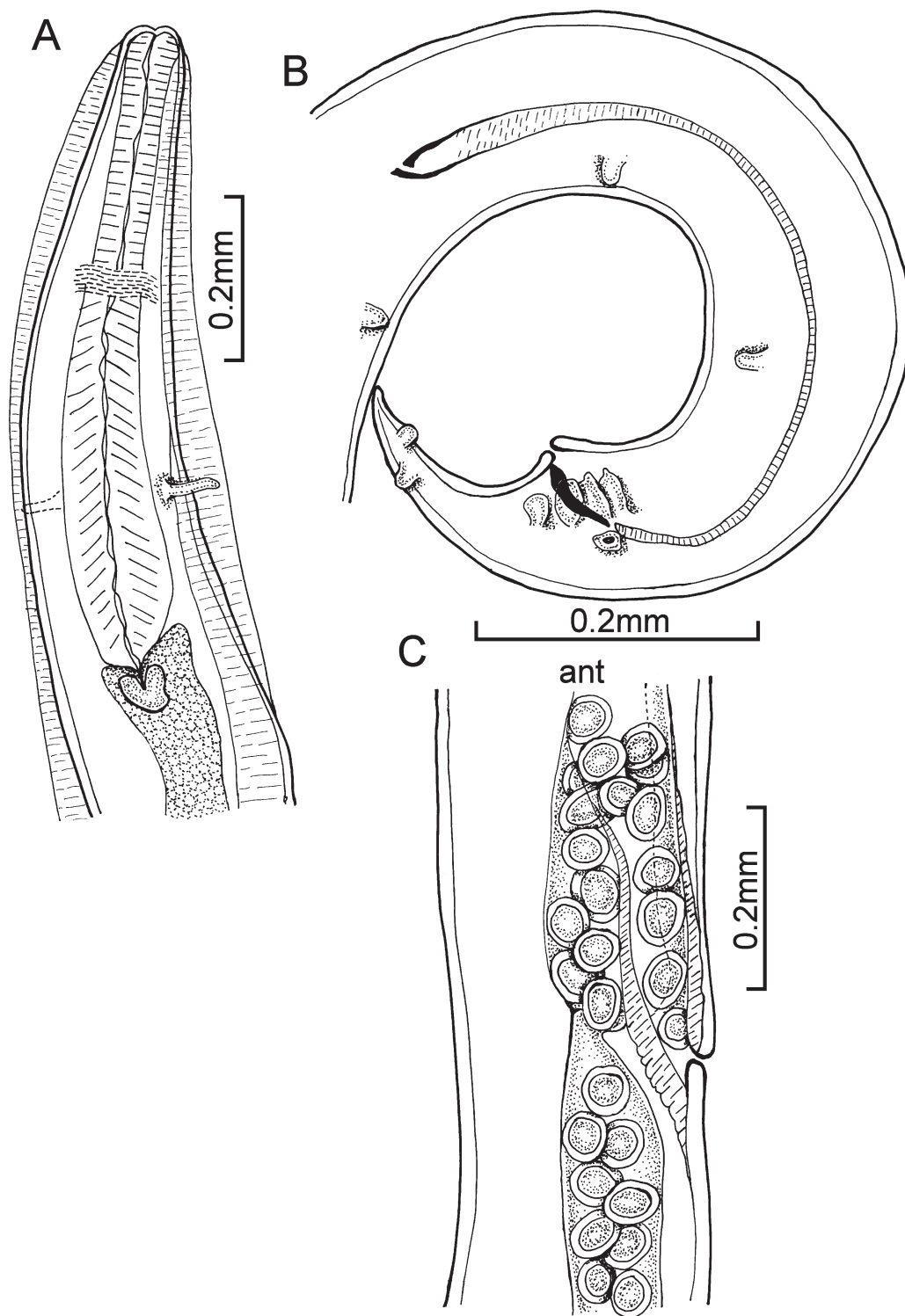


FIGURE 100. *Haplonema immutatum* Ward & Magath, 1917. A. male, anterior end, ventral view; B. male, posterior end, lateral view; C. female, vulvar region, lateral view. (Redrawn from Arthur & Margolis 1975)

***Paraquimperia* Baylis, 1934**

Generic diagnosis (after Moravec 2013). Quimperidae. Thread-like worms, anterior end dorsally bent. Cuticle with fine transverse striations. Broad lateral alae and deirids present. Head with three rudimentary lips, and small buccal cavity with three teeth. Muscular oesophagus comprises distinct pharyngeal region, narrow anterior portion

and wider posterior portion (Fig. 101A). Tail of both sexes conical, sharply pointed, that of males bent ventrad. Pre-cloacal region of males with distinct oblique muscle bands; caudal alae absent. Four pairs of pre-cloacal and seven pairs of post-cloacal papillae, plus one unpaired pre-cloacal papilla. Vulva in posterior third of body. Uteri amphidelphic. Eggs uncleaved, or cleaved into four blastomeres at most.

One species, *P. tenerrima*, is known from one fish species in Canada.

***Paraquimperia tenerrima* (von Linstow, 1878) Baylis, 1934**

Synonyms: *Haplonema aditum* Mueller, 1934; *Paraquimperia aditum* (Mueller, 1934) Moravec, 1966

Description (after Moravec 2013). With characteristics of the genus. Lateral alae up to 0.045 wide at anterior end of

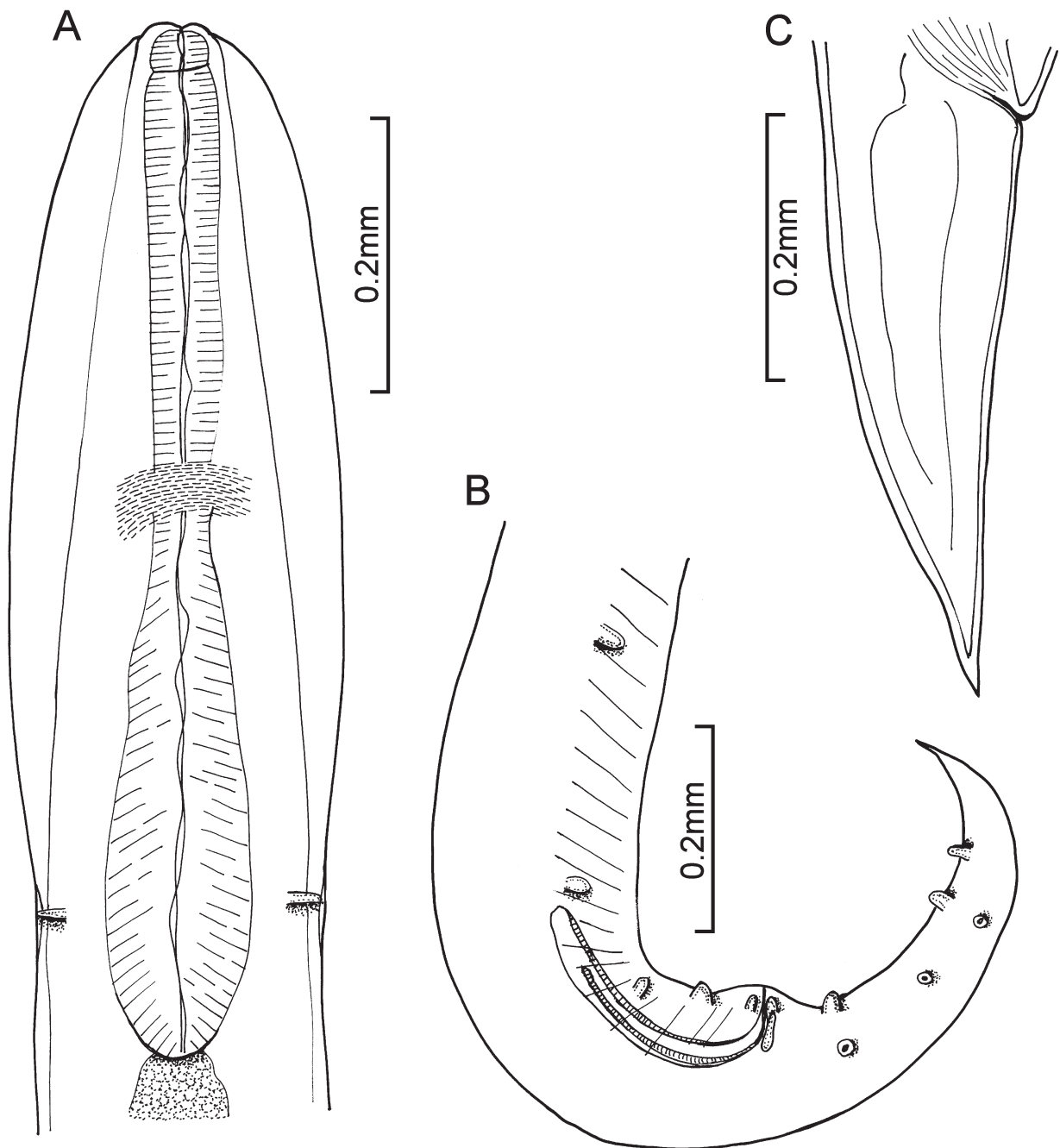


FIGURE 101. *Paraquimperia tenerrima* (von Linstow, 1878) Baylis, 1934. A. anterior end, dorsal view; B. male, posterior end, lateral view; C. female, tail, lateral view. (Redrawn from Moravec 2013)

body, becoming narrower behind deirids and extending posteriad along length of body. Mouth slightly depressed. Oesophagus opens into intestine through valves. Nerve ring about 0.28 from anterior end. Excretory pore located just posterior to nerve ring. Well developed deirids about 0.56 from anterior end.

Males: 4.3–11.2 long; maximum width 0.15–0.28. Entire oesophagus 0.78 long. Tail 0.34–0.44 long. About 30 pairs of oblique muscle bands anterior to cloaca; precloacal sucker absent. Eleven pairs caudal papillae. Spicules equal, somewhat sickle-shaped, 0.250–0.394 long, maximum width 0.021–0.027. Small gubernaculum, 0.063–0.069 long (Fig. 101B).

Females: 3.6–13.7 long; maximum width 0.11–0.29. Entire oesophagus 0.70–0.80 long. Tail straight, conical, 0.34–0.450 long (Fig. 101C). Lateral outlets of phasmids located behind mid-length of tail. Vulva in posterior third of body, situated more posteriorly in older than younger females. Vagina long, muscular, directed anteriorly. Eggs thin-walled, 0.060–0.072 x 0.048–0.051.

Sites: intestinal lumen, swim bladder

Host: *Anguilla rostrata*

Distribution: Atlantic, Labrador, Newfoundland, Nova Scotia, Ontario, Quebec

Records: Bangham and Venard 1946 (ON); Hanek & Threlfall 1970b (LB, NL); Hanek & Molnar 1974 (QC); Cone *et al.* 1993 (NS); Barker *et al.* 1996 (NS); Marcogliese & Cone 1996 (NS); Marcogliese & Cone 1998 (AT)

Superfamily METASTRONGYLOIDEA Cram, 1927

Family PSEUDALIIDAE Railliet, 1916

**Pharurus pallasii* (Van Beneden, 1870) Arnold & Gaskin, 1975

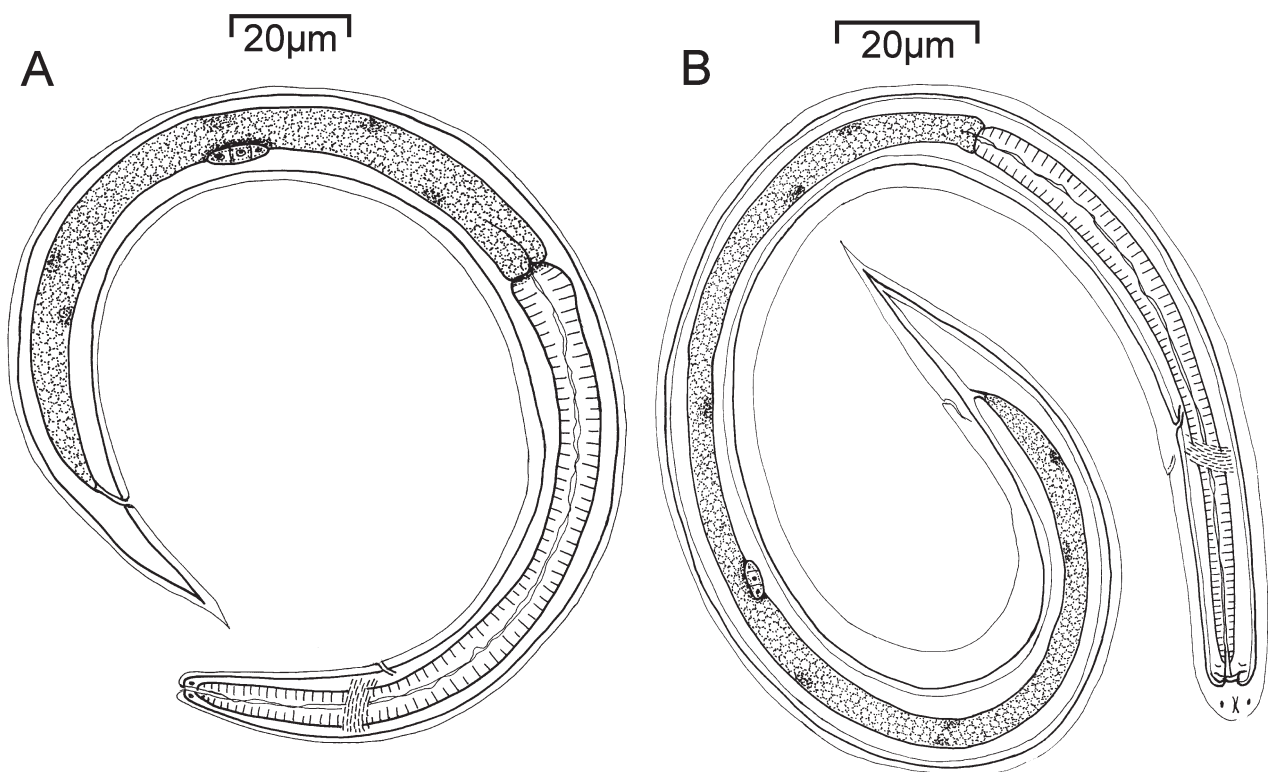


FIGURE 102. **Pharurus pallasii* (Van Beneden, 1870) Arnold & Gaskin, 1975. A. 1st-stage larva, lateral view; B. 2nd-stage larva within loose cuticle of 1st-stage larva, lateral view. (Redrawn from Houde *et al.* 2003)

Preamble: *Pharurus pallasii* matures in the cranial sinuses, middle ears, and Eustachian tubes of beluga whales (*Delphinapterus leucas*) in Canadian and other waters. Some 1st-stage larvae of *P. pallasii* intubated by Houde *et al.* (2003) into the stomach of Canadian-caught American plaice (*Hippoglossoides platessoides*) and Arctic

sculpins (*Myoxocephalus scorpioides*) moulted to 2nd stage in the intestinal wall of both fish species. A description of 1st- and 2nd-stage larvae of *P. pallasii* is provided here although evidence that fishes serve as intermediate hosts of the species in Canadian waters appears to be lacking.

First-stage larvae (measurements in μm): 295 \pm 21 long, 15 \pm 1 wide (Fig. 102A). Oesophagus 134 \pm 8 long. Nerve ring 62 \pm 5, excretory pore 66 \pm 7, and genital primordium 176 \pm 7 from anterior end. Tail 37 \pm 7 long, delicate, ending in sharp point.

Second-stage larvae (measurements in μm): 364 \pm 21.3 long, 12 \pm 1 wide, 2nd-stage larvae retain cuticle of the 1st stage (Fig. 102B). Oesophagus 166 \pm 30 long. Nerve ring 64 \pm 6, excretory pore 69 \pm 5, and genital primordium 212 \pm 34 from anterior end. Tail 33 \pm 7 long, resembles that of the 1st stage.

Site: intestinal wall

Hosts: *Hippoglossoides platessoides* (EX); *Myoxocephalus scorpioides* (EX)

Distribution: Quebec

Record: Houde, Measures & Huot 2003

****Nematoda gen. sp.**

Includes: *Agamonema* sp. auct.; *Agamospirura* sp. auct.

Sites: body cavity, intestinal lumen, mesenteries, musculature, pyloric caeca, stomach, swim bladder

Hosts: *Acipenser transmontanus* (68); *Ambloplites rupestris* (12); *Ameiurus nebulosus* (12); *Ammocrypta pellucida* (12); *Anoplopoma fimbria* (61); *Aplodinotus grunniens* (12); *Carassius auratus* (12); *Catostomus catostomus* (42); *Catostomus commersonii* (12, 22); *Clinocottus acuticeps* (70); *Clupea pallasii* (45, 63); *Coregonus artedii* (24, 30, 31); *Coregonus clupeaformis* (6, 8, 17, 26, 30, 31, 52); *Coregonus sardinella* (57); *Coryphaenoides rupestris* (66); *Culaea inconstans* (12, 46, 71); *Cymatogaster aggregata* (67); *Cyprinella spiloptera* (12); *Cyprinus carpio* (12); *Dorosoma cepedianum* (12); *Esox lucius* (16, 18, 30, 31, 56, 65); *Etheostoma exile* (12); *Etheostoma nigrum* (12); *Fundulus diaphanus* (12); *Gadus morhua* (75, 80); *Gasterosteus aculeatus* (79); *Glyptocephalus cynoglossus* (54); *Gobiesox maeandricus* (3); *Hexagrammos decagrammus* (44); *Hiodon alosoides* (42); *Hippoglossoides platessoides* (1, 69); *Hippoglossus stenolepis* (76); *Ictalurus punctatus* (12); *Labidesthes sicculus* (12); *Lepomis gibbosus* (7, 12, 14, 21, 3, 27, 34); *Lota lota* (18, 39, 59); *Macrhybopsis storeriana* (12); *Mallotus villosus* (11, 74); *Merluccius bilinearis* (69, 73); *Microgadus tomcod* (11); *Micropterus dolomieu* (12, 14, 46); *Micropterus salmoides* (12); *Morone chrysops* (12); *Myoxocephalus scorpius* (28); *Nocomis micropogon* (12); *Notemigonus crysoleucas* (12, 81); *Notropis atherinoides* (12); *Notropis heterodon* (12); *Notropis hudsonius* (12); *Oligocottus maculosus* (70); *Oncorhynchus clarkii* (13); *Oncorhynchus gorbuscha* (64); *Oncorhynchus keta* (64); *Oncorhynchus kisutch* (60, 64); *Oncorhynchus mykiss* (5, 51, 55, 60); *Oncorhynchus nerka* (36, 37, 43, 55, 60); *Oncorhynchus tshawytscha* (45, 55, 60, 64); *Ophiodon elongatus* (61); *Perca flavescens* (14, 21, 24, 25, 29, 56, 65, 78); *Percina caprodes* (12); *Percopsis omiscomaycus* (12, 27, 34); *Chrosomus eos* (14, 21); *Phoxinus neogaeus* (21); *Pimephales notatus* (14); *Platichthys stellatus* (45); *Pomoxis annularis* (12); *Prosopium cylindraceum* (47); *Prosopium williamsoni* (51, 55, 60); *Pseudopleuronectes americanus* (48); *Reinhardtius hippoglossoides* (77); *Salmo salar* (50); *Salvelinus alpinus* (28, 32, 35, 47, 53, 57, 58, 62); *Salvelinus fontinalis* (9, 10, 15, 22, 23, 47, 50); *Salvelinus malma* (5, 55, 60, 64); *Salvelinus namaycush* (15, 30, 40, 47, 57, 59); *Sander vitreus* (12, 16, 24, 59); *Sebastes nebulosus* (72); *Semotilus atromaculatus* (12, 14); *Tautoglabrus adspersus* (4); *Thymallus arcticus* (19); *Xiphias gladius* (41); *Zoarces americanus* (2, 20); unspecified “cod” (2, 38); unspecified “flounder” (2); unspecified “herring” (49); unspecified “sculpin” (52)

Distribution: Alberta, Atlantic, British Columbia, Labrador, Manitoba, New Brunswick, Nova Scotia, Northwest Territories, Nunavut, Ontario, Pacific, Quebec, Saskatchewan

Records: 1. Huntsman 1918 (AT); 2. Clemens 1920 (AT); 3. Fraser 1921 (PA); 4. Johansen 1925 (AT); 5. Neave & Bajkov 1929 (AB); 6. Bajkov 1930 (MB); 7. Reid 1930 (NB); 8. Hart 1931 (ON); 9. Ricker 1932 (ON); 10. Richardson 1935 (QC); 11. Pigeon & Vallee 1937 (QC); 12. Bangham & Hunter 1939 (ON); 13. Rawson 1939 (AB); 14. Bangham 1941 (ON); 15. MacLulich 1943 (ON); 16. McLeod 1943 (MB); 17. Miller 1944 (AB); 18. Miller 1945 (AB); 19. Miller 1946 (NT); 20. Olsen & Merriman 1946 (AT); 21. Bangham & Venard 1946 (ON); 22. Fantham & Porter 1948 (QC); 23. Choquette 1948a (QC); 24. Stewart-Hay 1951a (MB); 25.

Stewart-Hay 1951c (MB); 26. Wheaton & Hazen 1951 (SK); 27. Bangham 1951 (ON); 28. Dunbar & Hildebrand 1952 (NU); 29. Stewart-Hay 1952a (MB); 30. Stewart-Hay 1953a (MB); 31. Stewart-Hay 1953b (MB); 32. Andrews & Lear 1954 (LB); 33. Bangham & Adams 1954 (BC); 34. Bangham 1955 (ON); 35. Andrews & Lear 1956 (LB); 36. Margolis 1956 (BC, PA); 37. Margolis 1957 (BC); 38. Homans & MacFarlane 1958 (AT); 39. Fillion 1961 (AB); 40. Rawson 1961 (SK); 41. Tibbo *et al.* 1961 (AT); 42. Reed 1962 (SK); 43. Margolis 1963 (BC); 44. Barraclough 1967 (PA); 45. Robinson *et al.* 1968 (PA); 46. Dechtiar 1972a (ON); 47. Hicks & Threlfall 1973 (LB); 48. Wells *et al.* 1973 (AT); 49. Parsons & Hodder 1974 (AT); 50. Frantsi *et al.* 1975 (NS); 51. Mudry & Anderson 1977 (AB); 52. Pybus & Samuel 1978 (AB); 53. Stewart & MacDonald 1978 (NT); 54. Zubchenko 1980 (AT); 55. Anon. 1981 (BC); 56. Samuel 1981 (AB); 57. Stewart & Bernier 1982 (NT); 58. Stewart & Bernier 1983 (NT); 59. McAllister & Mudry 1983 (AB); 60. Anon. 1984 (BC); 61. E. A. Black 1984 (PA); 62. Stewart & Bernier 1984 (NT); 63. E. A. Black 1985 (PA); 64. Black & Low 1985 (PA); 65. Samuel 1985 (AB); 66. Zubchenko 1985b (AT); 67. Arai 1986 (PA); 68. Margolis & McDonald 1986 (BC); 69. Morrison *et al.* 1986 (AT); 70. Roth 1988 (PA); 71. Dechtiar *et al.* 1989 (ON); 72. Holmes 1990 (PA); 73. Waldron 1992 (AT); 74. Arthur *et al.* 1995 (AT); 75. Khan & Tuck 1995 (AT); 76. Blaycock 1996 (PA); 77. Boje *et al.* 1997 (AT); 78. Carney & Dick 2000 (MB); 79. Reimchen & Nosil 2001 (BC); 80. Khan & Chandra 2006 (LB); 81. Forest & Cone 2011 (ON)

HOST-NEMATODE PARASITE LIST

Preamble: As explained in the Introduction, a single asterisk (*) preceding a nematode's scientific name in any of the Keys denotes that the taxon has been recorded only as a larval stage in given fish host(s), a double asterisk (**) denotes records of both larvae and adults, whilst an unadorned taxon denotes records of adults only. For the sake of simplicity asterisks have been omitted from the various nematode taxa in the following List. Reference to the Keys will soon ascertain if a given taxon is represented by larvae, adults, or both larvae and adults.

Inevitably the List contains controversial records—for example the occurrence of *Cystidicola stigmatura* in *Coregonus* spp. (for discussion see p. 99 above).

The classification and scientific and common English nomenclature of fishes follow Page *et al.* (2013). For the few species occurring at depths greater than 200 m, and which are therefore outside the coverage of Page *et al.* (2013), we have consulted the on-line source FishBase (www.fishbase.org).

CLASS PETROMYZONTIDA

ORDER PETROMYZONTIFORMES

Family Petromyzontidae

<i>Lethenteron appendix</i> (DeKay)	American Brook Lamprey
<i>Truttaedacnitis pybusae</i>	
<i>Entosphenus tridentatus</i> (Gairdner)	Pacific Lamprey
<i>Eustrongylides</i> sp.	
<i>Petromyzon marinus</i> Linnaeus	Sea Lamprey
<i>Truttaedacnitis truttae</i>	

CLASS CHONDRICHTHYES

ORDER CHIMAERIFORMES

Family Chimaeridae

Hydrolagus colliei (Lay & Bennett)
Contracaecum sp.

Spotted Ratfish

Family Rhinochimaeridae

Rhinochimaera atlantica Holt & Byrne
Hysterothylacium aduncum

Atlantic Spearnose Chimaera

ORDER SQUALIFORMES

Family Squalidae

Squalus acanthias Linnaeus
Anisakis simplex
Anisakis sp.
Contracaecum sp.
Pseudanisakis tricipola
Pseudoterranova sp.

Spiny Dogfish

ORDER RAJIFORMES

Family Rajidae

Amblyraja radiata (Donovan)
Anisakis simplex
Anisakis sp.
Contracaecum sp.
Pseudanisakis tricipola
Pseudoterranova decipiens
Pseudoterranova sp.

Thorny Skate

Bathyraja interrupta (Gill & Townsend)
Piscicapillaria (Piscicapillaria) freemani

Sandpaper Skate

Dipturus laevis (Mitchill)
Anisakis sp.
Pseudanisakis tricipola

Barndoor Skate

Leucoraja erinacea (Mitchill)
Pseudanisakis tricipola

Little Skate

Leucoraja ocellata (Mitchill)
Anisakis sp.
Pseudoterranova sp.
Pseudanisakis tricipola

Winter Skate

Raja rhina Jordan & Gilbert
Anisakis sp.

Longnose Skate

Piscicapillaria (Piscicapillaria) freemani

Raja stellulata Jordan & Gilbert

Piscicapillaria (Piscicapillaria) freemani

Starry Skate

“skate”

Contracaecum sp. and/or *Phocascaris* sp.

Eustoma sp.

Pseudanisakis sp.

Pseudoterranova sp.

CLASS ACTINOPTERYGII

Family Acipenseridae

Acipenser brevirostrum Lesueur

Capillospirura pseudoargumentosa

Shortnose Sturgeon

Acipenser fulvescens Rafinesque

Camallanus sp.

Capillospirura pseudoargumentosa

Raphidascaris acus

Raphidascaris sp.

Rhabdochona cascadilla

Rhabdochonidae gen. sp.

Salmonema sp.

Spinitectus acipenseri

Spinitectus gracilis

Spinitectus sp.

Truttaedacnitis clitellarius

Lake Sturgeon

Acipenser oxyrinchus Mitchill

Capillospirura pseudoargumentosa

Truttaedacnitis sphaerocephala

Atlantic Sturgeon

Acipenser transmontanus Richardson

Anisakis simplex

Anisakis sp.

Cystoopsis acipenseris

Nematoda gen. sp.

Spiruroidea gen. sp.

White Sturgeon

ORDER LEPISOSTEIFORMES

Family Lepisosteidae

Lepisosteus osseus (Linnaeus)

Cystidicola lepisostei

Spiroxys sp.

Longnose Gar

ORDER AMIIFORMES

Family Amiidae

<i>Amia calva</i> Linnaeus	Bowfin
<i>Haplonema immutatum</i>	
<i>Spinitectus carolini</i>	

ORDER HIODONTIFORMES

Family Hiodontidae

<i>Hiodon alosoides</i> (Rafinesque)	Goldeye
<i>Camallanus oxycephalus</i>	
<i>Hiodon tergisus</i> Lesueur	Mooneye
<i>Nematoda</i> gen. sp.	
<i>Raphidascaris acus</i>	
<i>Rhabdochona canadensis</i>	
<i>Rhabdochona cascadilla</i>	
<i>Salmonema ephemeridarum</i>	
<i>Spinitectus macrospinosus</i>	

ORDER ANGUILLIFORMES

Family Anguillidae

<i>Anguilla rostrata</i> (Lesueur)	American Eel
<i>Anguillicola crassus</i>	
<i>Contracaecum</i> sp.	
<i>Daniconema anguillae</i>	
<i>Hysterothylacium brachyurum</i>	
<i>Paraquimperia tenerrima</i>	
<i>Salmonema ephemeridarum</i>	
<i>Spinitectus</i> sp.	

Family Synathobranchidae

<i>Synathobranchus kaupii</i> Johnson	Northern Cutthroat Eel
<i>Contracaecum</i> sp.	
<i>Hysterothylacium</i> sp.	

ORDER CLUPEIFORMES

Family Clupeidae

<i>Alosa aestivalis</i> (Mitchill)	Blueback Herring
<i>Anisakis simplex</i>	
<i>Anisakis</i> sp.	
<i>Hysterothylacium</i> sp.	

<i>Pseudoterranova decipiens</i>	
<i>Alosa pseudoharengus</i> (Wilson)	Alewife
<i>Anisakis simplex</i>	
<i>Anisakis</i> sp.	
<i>Hysterothylacium aduncum</i>	
<i>Hysterothylacium</i> sp.	
<i>Pseudoterranova decipiens</i>	
<i>Alosa sapidissima</i> (Wilson)	American Shad
<i>Ascarophis morrhuae</i>	
<i>Hysterothylacium aduncum</i>	
<i>Clupea harengus</i> Linnaeus	Atlantic Herring
<i>Anisakinae</i> gen. sp.	
<i>Anisakis simplex</i>	
<i>Anisakis</i> sp.	
<i>Hysterothylacium aduncum</i>	
<i>Pseudoterranova decipiens</i>	
<i>Clupea pallasii</i> Valenciennes	Pacific Herring
<i>Anisakis simplex</i>	
<i>Anisakis</i> sp.	
<i>Contracaecum</i> sp.	
<i>Hysterothylacium aduncum</i>	
Nematoda gen. sp.	
Oxyuroidea gen. sp.	
<i>Pseudoterranova decipiens</i>	
Spirurida gen. sp.	
<i>Dorosoma cepedianum</i> (Lesueur)	Gizzard Shad
Nematoda gen. sp.	
"herring"	
<i>Anisakis</i> sp.	
<i>Contracaecum</i> sp.	
Nematoda gen. sp.	

ORDER CYPRINIFORMES

Family Cyprinidae

<i>Acrocheilus alutaceus</i> Agassiz & Pickering	Chiselmouth
<i>Philonema</i> sp.	
<i>Rhabdochona cascadilla</i>	
<i>Carassius auratus</i> (Linnaeus)	Goldfish
Nematoda gen. sp.	
<i>Paracuaria adunca</i> (EX)	
<i>Syncuaria squamata</i> (EX)	

<i>Chrosomus eos</i> Cope	Northern Redbelly Dace
<i>Contracaecum</i> sp.	
Nematoda gen. sp.	
<i>Raphidascaris acus</i>	
<i>Rhabdochona canadensis</i>	
<i>Rhabdochona cascadilla</i>	
<i>Tetrameres</i> sp.	
<i>Chrosomus neogaeus</i> (Cope)	Finescale Dace
Nematoda gen. sp.	
<i>Rhabdochona canadensis</i>	
<i>Spiroxys</i> sp.	
<i>Couesius plumbeus</i> (Agassiz)	Lake Chub
<i>Pseudocapillaria (Pseudocapillaria) tomentosa</i>	
<i>Rhabdochona canadensis</i>	
<i>Rhabdochona cascadilla</i>	
<i>Rhabdochona</i> sp.	
<i>Cyprinella spiloptera</i> (Cope)	Spotfin Shiner
<i>Camallanus oxycephalus</i>	
Nematoda gen. sp.	
<i>Rhabdochona cascadilla</i>	
<i>Cyprinus carpio</i> Linnaeus	Common Carp
Nematoda gen. sp.	
<i>Pseudocapillaria (Pseudocapillaria) tomentosa</i>	
<i>Rhabdochona cascadilla</i>	
<i>Spinitectus carolini</i>	
<i>Spinitectus gracilis</i>	
<i>Cyprinus carpio</i> x <i>Carassius auratus</i>	
<i>Pseudocapillaria (Pseudocapillaria) tomentosa</i>	
<i>Luxilus cornutus</i> (Mitchill)	Common Shiner
<i>Contracaecum</i> sp.	
<i>Rhabdochona cascadilla</i>	
<i>Rhabdochona decaturensis</i>	
<i>Rhabdochona rotundicaudatum</i>	
<i>Rhabdochona</i> sp.	
<i>Spinitectus gracilis</i>	
<i>Spiroxys</i> sp.	
<i>Macrhybopsis storeriana</i> (Kirtland)	Silver Chub
Nematoda gen. sp.	
<i>Margariscus margarita</i> (Cox)	Allegheny Pearl Dace
<i>Rhabdochona canadensis</i>	
<i>Rhabdochona cascadilla</i>	
<i>Mylocheilus caurinus</i> (Richardson)	Peamouth
Capillariidae gen. sp.	

<i>Eustrongylides</i> sp.	
<i>Pseudocapillaria</i> (<i>Pseudocapillaria</i>) <i>tomentosa</i>	
<i>Rhabdochona cascadilla</i>	
<i>Rhabdochona</i> sp.	
<i>Truttaedacnitis</i> sp.	
<i>Nocomis biguttatus</i> (Kirtland)	Hornyhead Chub
<i>Rhabdochona cascadilla</i>	
<i>Rhabdochona rotundicaudatum</i>	
<i>Rhabdochona</i> sp.	
<i>Nocomis micropogon</i> (Cope)	River Chub
Nematoda gen. sp.	
<i>Rhabdochona rotundicaudatum</i>	
<i>Notemigonus crysoleucas</i> (Mitchill)	Golden Shiner
<i>Camallanus oxycephalus</i>	
<i>Hysterothylacium brachyurum</i>	
Nematoda gen. sp.	
<i>Raphidascaris acus</i>	
<i>Rhabdochona cascadilla</i>	
<i>Rhabdochona</i> sp.	
<i>Notropis anogenus</i> Forbes	Pugnose Shiner
<i>Rhabdochona cascadilla</i>	
<i>Notropis atherinoides</i> Rafinesque	Emerald Shiner
<i>Camallanus oxycephalus</i>	
<i>Contracaecum</i> sp.	
<i>Hysterothylacium brachyurum</i>	
Nematoda gen. sp.	
<i>Rhabdochona</i> sp.	
<i>Notropis buccatus</i> (Cope)	Silverjaw Minnow
<i>Camallanus oxycephalus</i>	
<i>Notropis heterodon</i> (Cope)	Blackchin Shiner
<i>Camallanus oxycephalus</i>	
Nematoda gen. sp.	
<i>Notropis heterolepis</i> Eigenmann & Eigenmann	Blacknose Shiner
<i>Camallanus oxycephalus</i>	
<i>Spiroxys</i> sp.	
<i>Notropis hudsonius</i> (Clinton)	Spottail Shiner
<i>Camallanus oxycephalus</i>	
<i>Contracaecum</i> sp.	
<i>Cosmocephalus obvelatus</i>	
Nematoda gen. sp.	
<i>Paracuaria adunca</i>	
<i>Raphidascaris acus</i>	
<i>Rhabdochona cascadilla</i>	

<i>Rhabdochona decaturensis</i>	
<i>Rhabdochona</i> sp.	
<i>Spinitectus gracilis</i>	
<i>Spiroxys</i> sp.	
<i>Notropis stramineus</i> (Cope)	Sand Shiner
<i>Camallanus oxycephalus</i>	
<i>Rhabdochona cascadilla</i>	
<i>Notropis volucellus</i> (Cope)	Mimic Shiner
<i>Rhabdochona cascadilla</i>	
<i>Pimephales notatus</i> (Rafinesque)	Bluntnose Minnow
Nematoda gen. sp.	
<i>Raphidascaris acus</i>	
<i>Rhabdochona cascadilla</i>	
<i>Spiroxys</i> sp.	
<i>Pimephales promelas</i> Rafinesque	Fathead Minnow
<i>Contracaecum</i> sp.	
<i>Raphidascaris acus</i>	
<i>Rhabdochona</i> sp.	
<i>Platygobio gracilis</i> (Richardson)	Flathead Chub
<i>Rhabdochona canadensis</i>	
<i>Ptychocheilus oregonensis</i> (Richardson)	Northern Pikeminnow
Capillariidae gen. sp.	
<i>Contracaecum spiculigerum</i>	
<i>Eustrongylides</i> sp.	
<i>Hysterothylacium</i> sp.	
<i>Pseudocapillaria</i> (<i>Pseudocapillaria</i>) <i>tomentosa</i>	
<i>Raphidascaris canadensis</i>	
<i>Rhabdochona cascadilla</i>	
<i>Rhabdochona</i> sp.	
<i>Spiroxys</i> sp.	
<i>Truttaedacnitis truttae</i>	
<i>Rhinichthys atratulus</i> (Hermann)	Blacknose Dace
<i>Rhabdochona cascadilla</i>	
<i>Rhinichthys cataractae</i> (Valenciennes)	Longnose Dace
<i>Camallanus oxycephalus</i>	
<i>Rhabdochona canadensis</i>	
<i>Rhabdochona cascadilla</i>	
<i>Rhabdochona milleri</i>	
<i>Salmonema ephemeridarum</i>	
<i>Spiroxys</i> sp.	
<i>Truttaedacnitis</i> sp.	
<i>Richardsonius balteatus</i> (Richardson)	Redside Shiner
<i>Pseudocapillaria</i> (<i>Pseudocapillaria</i>) <i>tomentosa</i>	

Rhabdochona cascadilla

Rhabdochona sp.

Spiroxys sp.

Truttaedacnitis sp.

Semotilus atromaculatus (Mitchill)

Creek Chub

Cosmocephalus obvelatus

Paracuaria adunca

Nematoda gen. sp.

Rhabdochona canadensis

Rhabdochona cascadilla

Rhabdochona rotundicaudatum

Rhabdochona sp.

Spiroxys sp.

Semotilus corporalis (Mitchill)

Fallfish

Rhabdochona canadensis

Rhabdochona cascadilla

Tinca tinca (Linnaeus)

Tench

Raphidascaris acus

“carp”

Pseudocapillaria (Pseudocapillaria) tomentosa

“lake chub”

Pseudocapillaria (Pseudocapillaria) tomentosa

Rhabdochona canadensis

Rhabdochona cascadilla

Rhabdochona sp.

"dace"

Salmonema ephemeridarum

Family Catostomidae

Carpionodes cyprinus (Lesueur)

Quillback

Camallanus ancyloDIRUS

Camallanus oxycephalus

Philometroides nodulosus

Rhabdochona cascadilla

Rhabdochona milleri

Catostomus catostomus (Forster)

Longnose Sucker

Cystidicola farionis

Eustrongylides tubifex

Nematoda gen. sp.

Philometra sp.

Philometroides huronensis

Philometroides nodulosus

Pseudocapillaria (Pseudocapillaria) tomentosa

<i>Raphidascaris acus</i>	
<i>Rhabdochona cascadilla</i>	
<i>Rhabdochona catostomi</i>	
<i>Rhabdochona ovifilamenta</i>	
<i>Rhabdochona</i> sp.	
<i>Catostomus columbianus</i> (Eigenmann & Eigenmann)	Bridgelip Sucker
<i>Hysterothylacium</i> sp.	
<i>Catostomus commersonii</i> (Lacépède)	White Sucker
<i>Camallanus oxycephalus</i>	
<i>Contracaecum</i> sp.	
<i>Capillaria</i> (<i>Capillaroides</i>) <i>catenata</i>	
<i>Eustrongylides</i> sp.	
<i>Eustrongylides tubifex</i>	
Nematoda gen. sp.	
<i>Philometra kobuleji</i>	
<i>Philometra</i> sp.	
<i>Philometroides huronensis</i>	
<i>Philometroides nodulosus</i>	
<i>Philometroides</i> sp.	
<i>Philonema</i> sp.	
<i>Pseudocapillaria</i> (<i>Pseudocapillaria</i>) <i>tomentosa</i>	
<i>Raphidascaris acus</i>	
<i>Rhabdochona canadensis</i>	
<i>Rhabdochona cascadilla</i>	
<i>Rhabdochona ovifilamenta</i>	
<i>Rhabdochona</i> sp.	
<i>Spinitectus gracilis</i>	
<i>Spiroxys</i> sp.	
<i>Catostomus macrocheilus</i> Girard	Largescale Sucker
<i>Eustrongylides</i> sp.	
<i>Philometroides huronensis</i>	
<i>Pseudocapillaria</i> (<i>Pseudocapillaria</i>) <i>tomentosa</i>	
<i>Rhabdochona cascadilla</i>	
<i>Rhabdochona zacconis</i>	
<i>Rhabdochona</i> sp.	
<i>Spiroxys</i> sp.	
<i>Catostomus platyrhynchus</i> (Cope)	Mountain Sucker
<i>Rhabdochona ovifilamenta</i>	
<i>Rhabdochona</i> sp.	
<i>Hypentelium nigricans</i> (Lesueur)	Northern Hogsucker
<i>Philometra</i> sp.	
<i>Moxostoma anisurum</i> (Rafinesque)	Silver Redhorse
<i>Contracaecum</i> sp.	
<i>Hysterothylacium brachyurum</i>	
<i>Raphidascaris acus</i>	
<i>Raphidascaris canadensis</i>	

Spinitectus gracilis

Moxostoma erythrurum (Rafinesque)
Rhabdochona milleri

Golden Redhorse

Moxostoma macrolepidotum (Leseuer)
Philometroides huronensis
Rhabdochona cascadilla
Rhabdochona milleri

Shorthead Redhorse

ORDER SILURIFORMES

Family Ictaluridae

Ameiurus melas (Rafinesque)
Cucullanellus cotylophora
Dichelyne robustus
Rhabdochona sp.

Black Bullhead

Ameiurus nebulosus (Lesueur)
Camallanus oxycephalus
Capillaria sp.
Contracecum sp.
Cucullanellus cotylophora
Dichelyne robustus
Dioctophyme renale
Eustrongylides tubifex
Nematoda gen. sp.
Rhabdochona cascadilla
Rhabdochona rotundicaudatum
Rhabdochona sp.
Salmonema prevosti
Spinitectus carolini
Spinitectus gracilis
Spiroxys contortus
Spiroxys sp.

Brown Bullhead

Ictalurus punctatus (Rafinesque)
Camallanus oxycephalus
Eustrongylides tubifex
Nematoda gen. sp.
Raphidascaris acus
Spinitectus gracilis
Spinitectus macrospinosus

Channel Catfish

Noturus flavus Rafinesque
Camallanus oxycephalus
Hysterothylacium brachyurum
Rhabdochona canadensis
Rhabdochona decaturensis
Spinitectus gracilis

Stonecat

Spinitectus macrospinosus

Noturus gyrinus (Mitchill)

Rhabdochona decaturensis

Tadpole Madtom

ORDER ARGENTINIFORMES

Family Argentinidae

Argentina silus (Ascanius)

Anisakis simplex

Atlantic Argentine

ORDER OSMERIFORMES

Family Osmeridae

Hypomesus pretiosus (Girard)

Contracaecum sp.

Hysterothylacium aduncum

Surf Smelt

Mallotus villosus (Müller)

Anisakis simplex

Anisakis sp.

Ascarophis sp.

Contracaecinea gen. sp.

Contracaecum osculatum

Contracaecum sp.

Contracaecum sp. and/or *Phocascaris* sp.

Hysterothylacium aduncum

Hysterothylacium sp.

Nematoda gen. sp.

Phocascaris sp.

Pseudoterranova decipiens

Spirurida gen. sp.

Capelin

Osmerus mordax (Mitchill)

Anisakis sp.

Ascarophis arctica

Capillaria (Capillaroides) catenata

Cosmocephalus obvelatus

Cystidicola farionis

Cystidicola stigmatura

Hysterothylacium sp.

Philometra sp.

Philonema agubernaculum

Pseudocapillaria (Ichthyocapillaria) salvelini

Pseudoterranova decipiens

Pseudoterranova sp.

Spinitectus carolini

Rainbow Smelt

Spinitectus gracilis

Thaleichthys pacificus (Richardson)
Contracaecum sp.

Eulachon

Family Alepocephalidae

Alepocephalus agassizii Goode & Bean
Anisakis sp.

Agassiz' Slickhead

ORDER SALMONIFORMES

Family Salmonidae

Coregonus artedii Lesueur

Lake Cisco

Cystidicola farionis

Cystidicola serratus

Cystidicola sp.

Cystidicola stigmatura

Hysterothylacium brachyurum

Nematoda gen. sp.

Philometra sp.

Philonema agubernaculum

Philonema sp.

Raphidascaris acus

Raphidascaris sp.

Salmonema ephemeridarum

Spinitectus gracilis

Coregonus clupeaformis (Mitchill)

Lake Whitefish

Contracaecum sp.

Cystidicola farionis

Cystidicola sp.

Cystidicola stigmatura

Hysterothylacium sp.

Nematoda gen. sp.

Philometra sp.

Philonema agubernaculum

Philonema sp.

Pseudocapillaria (Ichthyocapillaria) salvelini

Pseudocapillaria (Pseudocapillaria) tomentosa

Raphidascaris acus

Raphidascaris sp.

Rhabdochona sp.

Salmonema ephemeridarum

Spinitectus carolini

Spinitectus gracilis

Truttaedacnitis truttae

Coregonus hoyi (Milner)

Bloater

<i>Cystidicola farionis</i>	
<i>Cystidicola</i> sp.	
<i>Cystidicola stigmatura</i>	
<i>Coregonus huntsmani</i> Scott	Atlantic Whitefish
<i>Anisakis simplex</i>	
<i>Pseudoterranova decipiens</i>	
<i>Coregonus kiyi</i> (Koelz)	Kiyi
<i>Cystidicola</i> sp.	
<i>Coregonus nasus</i> (Pallas)	Broad Whitefish
<i>Ascarophis</i> sp.	
<i>Cystidicola farionis</i>	
<i>Raphidascaris</i> sp.	
<i>Coregonus nigripinnis</i> (Milner)	Blackfin Cisco
<i>Cystidicola farionis</i>	
<i>Coregonus reighardi</i> (Koelz)	Shortnose Cisco
<i>Cystidicola farionis</i>	
<i>Cystidicola</i> sp.	
<i>Coregonus sardinella</i> Valenciennes	Least Cisco
Nematoda gen. sp.	
<i>Oncorhynchus clarkii</i> (Richardson)	Cutthroat Trout
<i>Contracaecum</i> sp.	
<i>Eustrongylides</i> sp.	
Nematoda gen. sp.	
<i>Philonema oncorhynchi</i>	
<i>Philonema</i> sp.	
<i>Pseudocapillaria</i> (<i>Pseudocapillaria</i>) <i>tomentosa</i>	
<i>Rhabdochona cascadilla</i>	
<i>Rhabdochona milleri</i>	
<i>Salmonema ephemeridarum</i>	
<i>Salvelinema walkeri</i>	
<i>Truttaedacnitis truttae</i>	
<i>Oncorhynchus gorbuscha</i> (Walbaum)	Pink Salmon
<i>Anisakis simplex</i>	
<i>Anisakis</i> sp.	
<i>Ascarophis</i> sp.	
<i>Contracaecum</i> sp.	
<i>Cystidicola farionis</i>	
<i>Cystidicola stigmatura</i>	
<i>Hysterothylacium aduncum</i>	
Nematoda gen. sp.	
<i>Philonema oncorhynchi</i>	
<i>Raphidascaris acus</i>	
<i>Oncorhynchus keta</i> (Walbaum)	Chum Salmon

Anisakis simplex
Anisakis sp.
Contracaecum sp.
Hysterothylacium aduncum
Nematoda gen. sp.
Salvelinema walkeri

Oncorhynchus kisutch (Walbaum)

Coho Salmon

Anisakis sp.
Ascarophis sebastodis
Camallanus oxycephalus
Capillaria sp.
Contracaecum sp.
Cucullanus sp.
Cystidicola farionis
Cystidicola stigmatura
Eustrongylides sp.
Hysterothylacium aduncum
Nematoda gen. sp.
Philonema agubernaculum
Philonema oncorhynchi
Philonema sp.
Pseudocapillaria (Ichthyocapillaria) salvelini
Pseudocapillaria (Pseudocapillaria) tomentosa
Rhabdochona kisutchi
Rhabdochona sp.
Salmonema ephemeridarum
Salvelinema salmonicola
Salvelinema walkeri

Oncorhynchus mykiss (Walbaum)

Rainbow Trout

Anisakis simplex
Capillariidae gen. sp.
Contracaecum sp.
Cystidicola farionis
Cystidicola sp.
Eustrongylides sp.
Haplonema hamatulum [sic] for *H. hamulatum*
Haplonema hamulatum
Hysterothylacium aduncum
Hysterothylacium sp.
Nematoda gen. sp.
Philonema agubernaculum
Philonema oncorhynchi
Philonema sp.
Pseudocapillaria (Ichthyocapillaria) salvelini
Pseudocapillaria (Pseudocapillaria) tomentosa
Pseudoterranova decipiens
Rhabdochona canadensis
Rhabdochona cascadii
Rhabdochona kisutchi
Rhabdochona milleri

Rhabdochona sp.
Salmonema ephemeridarum
Spirurida gen. sp.
Truttaedacnitis truttae

Oncorhynchus nerka (Walbaum)

Sockeye Salmon

Anisakis sp.
Ascarophis sebastodis
Capillaria (Capillaroides) catenata
Contracaecum spiculigerum
Contracaecum sp.
Cystidicola farionis
Cystidicola stigmatura
Hysterothylacium aduncum
Hysterothylacium sp.
Nematoda gen. sp.
Philonema agubernaculum
Philonema oncorhynchi
Philonema sp.
Pseudoterranova sp.
Rhabdochona cascadilla
Rhabdochona kisutchi
Rhabdochona sp.
Salmonema ephemeridarum
Spinitectus gracilis
Truttaedacnitis truttae

Oncorhynchus tshawytscha (Walbaum)

Chinook Salmon

Anisakis simplex
Anisakis sp.
Capillaria sp.
Contracaecum osculatum
Contracaecum sp.
Cystidicola farionis
Cystidicola sp.
Nematoda gen. sp.
Philonema oncorhynchi
Philonema sp.
Rhabdochona sp.
Salvelinema walkeri

Prosopium coulterii (Eigenmann & Eigenmann)

Pygmy Whitefish

Cystidicola farionis
Cystidicola sp.
Rhabdochona milleri

Prosopium cylindraceum (Pennant)

Round Whitefish

Cystidicola farionis
Cystidicola stigmatura
Eustrongylides sp.
Nematoda gen. sp.
Philometra sp.

Philonema agubernaculum
Philonema sp.
Pseudocapillaria (Ichthyocapillaria) salvelini
Salmonema ephemeridarum
Spinitectus gracilis
Truttaedacnitis sp.
Truttaedacnitis truttae

<i>Prosopium williamsoni</i> (Girard)	Mountain Whitefish
<i>Anisakidae</i> gen. sp.	
<i>Cystidicola farionis</i>	
<i>Cystidicola</i> sp.	
<i>Eustrongylides</i> sp.	
<i>Haplonema hamatulum</i> [sic] for <i>H. hamulatum</i>	
<i>Haplonema hamulatum</i>	
<i>Hysterothylacium</i> sp.	
Nematoda gen. sp.	
<i>Philonema agubernaculum</i>	
<i>Philonema</i> sp.	
<i>Pseudocapillaria (Pseudocapillaria) tomentosa</i>	
<i>Rhabdochona cascadilla</i>	
<i>Rhabdochona kisutchi</i>	
<i>Rhabdochona milleri</i>	
<i>Rhabdochona</i> sp.	
<i>Salmonema ephemeridarum</i>	
<i>Truttaedacnitis</i> sp.	
<i>Truttaedacnitis truttae</i>	

<i>Salmo salar</i> Linnaeus	Atlantic Salmon
<i>Anisakis simplex</i>	
<i>Anisakis</i> sp.	
<i>Camallanus oxycephalus</i>	
<i>Contracaecum</i> sp.	
<i>Hysterothylacium aduncum</i>	
Nematoda gen. sp.	
<i>Philonema agubernaculum</i>	
<i>Pseudocapillaria (Ichthyocapillaria) salvelini</i>	
<i>Pseudoterranova decipiens</i>	
<i>Raphidascaris</i> sp.	
<i>Salmonema ephemeridarum</i>	

<i>Salmo trutta</i> Linnaeus	Brown Trout
<i>Cystidicola farionis</i>	
<i>Salmonema ephemeridarum</i>	

<i>Salvelinus alpinus</i> (Linnaeus)	Arctic Char
<i>Anisakis simplex</i>	
<i>Anisakis</i> sp.	
<i>Contracaecum</i> sp.	
<i>Contracaecinea</i> gen. sp.	
<i>Cystidicola farionis</i>	
<i>Cystidicola</i> sp.	

Cystidicola stigmatura
Hysterothylacium aduncum
 Nematoda gen. sp.
Philonema agubernaculum
Philonema sp.
Pseudocapillaria (Ichthyocapillaria) salvelini
Pseudoterranova decipiens
Salmonema ephemeridarum
Truttaedacnitis truttae

Salvelinus fontinalis (Mitchill)

Brook Trout

Anisakis simplex
Anisakis sp.
Contracaecum sp.
Cystidicola farionis
Cystidicola stigmatura
Eustrongylides sp.
Hysterothylacium aduncum
Hysterothylacium brachyurum
Hysterothylacium sp.
 Nematoda gen. sp.
Philometra cylindracea
Philometra sp.
Philonema agubernaculum
Philonema sp.
Pseudocapillaria (Ichthyocapillaria) salvelini
Pseudocapillaria (Pseudocapillaria) tomentosa
Raphidascaris acus
Raphidascaris sp.
Rhabdochona cascadilla
Rhabdochona milleri
Rhabdochona ovifilamenta
Rhabdochona sp.
Salmonema ephemeridarum
 Seuratiinae gen. sp.
Truttaedacnitis sp.
Truttaedacnitis truttae

Salvelinus malma (Walbaum)

Dolly Varden

Contracaecum sp.
Cystidicola farionis
Eustrongylides sp.
Hysterothylacium brachyurum
Hysterothylacium sp.
 Nematoda gen. sp.
Haplonema hamatulum [sic] for *H. hamulatum*
Haplonema hamulatum
Philonema agubernaculum
Philonema oncorhynchi
Philonema sp.
Pseudocapillaria (Ichthyocapillaria) salvelini
Pseudocapillaria (Pseudocapillaria) tomentosa

Rhabdochona canadensis
Rhabdochona kisutchi
Rhabdochona milleri
Rhabdochona sp.
Salmonema ephemeridarum
Salvelinema salmonicola
Truttaedacnitis truttae

Salvelinus namaycush (Walbaum)

Lake Trout

Cystidicola farionis
Cystidicola sp.
Cystidicola stigmatura
Eustrongylides sp.
Hysterothylacium aduncum
Hysterothylacium brachyurum
Nematoda gen. sp.
Philonema agubernaculum
Philonema sp.
Pseudocapillaria (Ichthyocapillaria) salvelini
Raphidascaris acus
Raphidascaris sp.
Salmonema ephemeridarum
Truttaedacnitis truttae

Thymallus arcticus (Pallas)

Arctic Grayling

Cystidicola farionis
Metabronema sp.
Nematoda gen. sp.
Philonema sp.
Pseudocapillaria (Ichthyocapillaria) salvelini
Raphidascaris acus
Rhabdochona cascadilla
Salmonema ephemeridarum

“salmonids”

Cystidicola farionis
Salmonema ephemeridarum

“splake”

Cystidicola farionis
Cystidicola stigmatura
Hysterothylacium brachyurum
Pseudocapillaria (Ichthyocapillaria) salvelini
Rhabdochona sp.
Spinitectus gracilis

“whitefish”

Cystidicola farionis
Philonema sp.

ORDER ESOCIFORMES

Family Esocidae

<i>Esox americanus americanus</i> Gmelin <i>Cystidicola farionis</i>	Redfin Pickerel
<i>Esox americanus vermiculatus</i> Lesueur <i>Cucullanellus cotylophora</i> <i>Spinitectus gracilis</i>	Grass Pickerel
<i>Esox lucius</i> Linnaeus <i>Camallanus oxycephalus</i> <i>Camallanus</i> sp. <i>Contracaecum</i> sp. <i>Cystidicola</i> sp. <i>Hysterothylacium brachyurum</i> Nematoda gen. sp. <i>Philonema</i> sp. <i>Raphidascaris acus</i> <i>Raphidascaris</i> sp. <i>Rhabdochona canadensis</i> <i>Spinitectus carolini</i> <i>Spinitectus gracilis</i>	Northern Pike
<i>Esox masquinongy</i> Mitchill <i>Hysterothylacium brachyurum</i> <i>Raphidascaris acus</i> <i>Salmonema ephemeridarum</i>	Muskellunge
<i>Esox niger</i> Lesueur <i>Philometra</i> sp.	Chain Pickerel
<i>Umbra limi</i> (Kirtland) <i>Raphidascaris acus</i> <i>Spiroxys</i> sp.	Central Mudminnow

ORDER PERCOPSIFORMES

Family Percopsidae

<i>Percopsis omiscomaycus</i> (Walbaum) <i>Camallanus oxycephalus</i> <i>Hysterothylacium brachyurum</i> Nematoda gen. sp. <i>Raphidascaris acus</i> <i>Rhabdochona canadensis</i> <i>Rhabdochona cascadilla</i> <i>Rhabdochona</i> sp. <i>Spinitectus gracilis</i>	Trout-perch
---	-------------

ORDER GADIFORMES

Family Macrouridae

<i>Coryphaenoides rupestris</i> Gunnerus	Roundnose Grenadier
<i>Anisakis</i> sp.	
<i>Contracaecum</i> sp.	
<i>Hysterothylacium aduncum</i>	
Nematoda gen. sp.	
<i>Macrourus berglax</i> Lacépède	Roughhead Grenadier
<i>Anisakis</i> sp.	
<i>Capillaria (Procapillaria) gracilis</i>	
<i>Hysterothylacium aduncum</i>	
<i>Hysterothylacium</i> sp.	
<i>Spinitectus</i> sp.	
<i>Nezumia bairdii</i> (Goode & Bean)	Marlin-spike
<i>Anisakis simplex</i>	
<i>Capillaria (Procapillaria) gracilis</i>	
<i>Contracaecum</i> sp. and/or <i>Phocascaris</i> sp.	
<i>Hysterothylacium aduncum</i>	
<i>Hysterothylacium</i> sp.	
<i>Pseudoterranova decipiens</i>	

Family Merlucciidae

<i>Merluccius albidus</i> (Mitchill)	Offshore Hake
<i>Anisakis</i> sp.	
<i>Capillaria (Procapillaria) gracilis</i>	
<i>Hysterothylacium aduncum</i>	
<i>Merluccius bilinearis</i> (Mitchill)	Silver Hake
<i>Anisakis simplex</i>	
<i>Anisakis</i> sp.	
<i>Ascarophis arctica</i>	
<i>Capillaria (Procapillaria) gracilis</i>	
<i>Hysterothylacium aduncum</i>	
<i>Hysterothylacium</i> sp.	
Nematoda gen. sp.	
<i>Pseudoterranova decipiens</i>	
<i>Merluccius productus</i> (Ayres)	Pacific Hake
<i>Anisakis simplex</i>	
<i>Anisakis</i> sp.	
<i>Ascarophis</i> sp.	
<i>Contracaecum</i> sp.	
<i>Hysterothylacium aduncum</i>	
<i>Pseudoterranova decipiens</i>	

"hake"

Pseudoterranova decipiens

Family Phycidae

<i>Enchelyopus cimbrius</i> (Linnaeus) <i>Pseudoterranova decipiens</i>	Fourbeard Rockling
<i>Phycis chesteri</i> (Goode & Bean) <i>Anisakis simplex</i> <i>Hysterothylacium aduncum</i> <i>Pseudoterranova decipiens</i> <i>Spinitectus cristatus</i>	Longfin Hake
<i>Urophycis chuss</i> (Walbaum) <i>Anisakis simplex</i> <i>Anisakis</i> sp. <i>Capillaria (Procapillaria) gracilis</i> <i>Hysterothylacium aduncum</i> <i>Pseudoterranova decipiens</i> <i>Spinitectus cristatus</i>	Red Hake
<i>Urophycis tenuis</i> (Mitchill) <i>Anisakis simplex</i> <i>Anisakis</i> sp. <i>Ascarophis arctica</i> <i>Capillaria (Procapillaria) gracilis</i> <i>Contracaecum osculatum</i> <i>Contracaecum</i> sp. and/or <i>Phocascaris</i> sp. <i>Cucullanus cirratus</i> <i>Hysterothylacium aduncum</i> <i>Pseudoterranova decipiens</i> <i>Spinitectus cristatus</i> <i>Spinitectus</i> sp.	White Hake

Family Gadidae

<i>Boreogadus saida</i> (Lepechin) <i>Anisakis simplex</i> <i>Ascarophis filiformis</i> <i>Contracaecum osculatum</i> <i>Hysterothylacium</i> sp. <i>Pseudoterranova decipiens</i>	Arctic Cod
<i>Brosme brosme</i> (Ascanius) <i>Anisakis simplex</i> <i>Pseudoterranova decipiens</i>	Cusk
<i>Gadus macrocephalus</i> Tilesius <i>Anisakis simplex</i> <i>Anisakis</i> sp. <i>Ascarophis</i> sp. <i>Contracaecum osculatum</i> <i>Contracaecum</i> sp. and/or <i>Phocascaris</i> sp.	Pacific Cod

Hysterothylacium aduncum
Pseudoterranova bulbosa
Pseudoterranova decipiens
Pseudoterranova sp.

Gadus morhua Linnaeus

Atlantic Cod

Anisakidae gen. sp.
Anisakis simplex
Anisakis sp.
Ascarophis arctica
Ascarophis extalicola
Ascarophis filiformis
Ascarophis morrhuae
Capillaria sp.
Contracaecinea gen. sp.
Contracaecum osculatum
Contracaecum sp.
Contracaecum sp. and/or *Phocascaris* sp.
Cucullanus cirratus
Hysterothylacium aduncum
Hysterothylacium sp.
Nematoda gen. sp.
Phocascaris sp.
Pseudoterranova decipiens
Pseudoterranova sp.

Lota lota (Linnaeus)

Burbot

Camallanus oxycephalus
Cucullanellus cotylophora
Eustrongylides sp.
Haplonema hamatulum [sic] for *H. hamulatum*
Haplonema hamulatum
Haplonema sp.
Hysterothylacium brachyurum
Nematoda gen. sp.
Pseudocapillaria (*Pseudocapillaria*) *tomentosa*
Raphidascaris acus
Rhabdochona cascadilla
Spinitectus gracilis

Melanogrammus aeglefinus (Linnaeus)

Haddock

Anisakis simplex
Anisakis sp.
Ascarophis arctica
Ascarophis extalicola
Capillaria sp.
Contracaecum sp.
Contracaecum sp. and/or *Phocascaris* sp.
Cucullanus cirratus
Hysterothylacium aduncum
Hysterothylacium melanogrammi
Hysterothylacium sp.

Pseudoterranova decipiens

Pseudoterranova sp.

Microgadus tomcod (Walbaum)

Atlantic Tomcod

Anguillicola crassus

Anisakis simplex

Anisakis sp.

Ascarophis arctica

Hysterothylacium aduncum

Nematoda gen. sp.

Pseudoterranova decipiens

Pseudoterranova sp.

Pollachius virens (Linnaeus)

Pollock

Anisakidae gen. sp.

Anisakis simplex

Anisakis sp.

Cucullanus cirratus

Hysterothylacium sp.

Pseudoterranova decipiens

Theragra chalcogramma Pallas

Walleye Pollock

Anisakis simplex

Anisakis sp.

Ascarophis sp.

Contracaecum osculatum

Contracaecum sp.

Contracaecum sp. and/or *Phocascaris* sp.

Hysterothylacium aduncum

Pseudoterranova decipiens

Pseudoterranova sp.

Spirurida gen. sp.

"cod"

Nematoda gen. sp.

Pseudoterranova decipiens

Pseudoterranova sp.

ORDER LOPHIIFORMES

Family Lophiidae

Lophius americanus Valenciennes

Goosefish

Anisakis simplex

Pseudoterranova decipiens

Pseudoterranova sp.

ORDER ATHERINIFORMES

Family Atherinopsidae

<i>Labidesthes sicculus</i> (Cope)	Brook Silverside
<i>Camallanus oxycephalus</i>	
Nematoda gen. sp.	

<i>Menidia menidia</i>	Atlantic silverside
<i>Pseudoterranova decipiens</i>	

Family Scomberesocidae

<i>Scomberesox saurus</i> (Walbaum)	Atlantic Saury
<i>Anisakis simplex</i>	

ORDER CYPRINODONTIFORMES

Family Fundulidae

<i>Fundulus diaphanus</i> (Lesueur)	Banded Killifish
<i>Camallanus oxycephalus</i>	
<i>Cucullanus</i> sp.	
<i>Cystidicola</i> sp.	
<i>Eustrongylides tubifex</i>	
<i>Hedruris</i> sp.	
<i>Hysterothylacium</i> sp.	
Nematoda gen. sp.	
<i>Raphidascaris acus</i>	
<i>Rhabdochona</i> sp.	
<i>Spiroxys</i> sp.	

<i>Fundulus heteroclitus</i> (Linnaeus)	Mummichog
<i>Contracaecinea</i> gen. sp.	
<i>Cosmocephalus obvelatus</i>	
<i>Paracuaria adunca</i>	

Family Poeciliidae

<i>Poecilia reticulata</i> Peters	Guppy
<i>Contracaecum rudolphii</i> (EX)	

ORDER GASTEROSTEIFORMES

Family Aulorhynchidae

<i>Aulorhynchus flavidus</i> Gill	Tube-snout
<i>Anisakis</i> sp.	
<i>Ascarophis sebastodis</i>	
<i>Contracaecum</i> sp.	
<i>Hysterothylacium aduncum</i>	
<i>Philometra</i> sp.	

Family Gasterosteidae

<i>Apeltes quadracus</i> (Mitchill) <i>Contracaecum</i> sp. <i>Cosmocephalus obvelatus</i> <i>Cystidicola farionis</i> <i>Paracuaria adunca</i> <i>Pseudoterranova decipiens</i>	Fourspine Stickleback
<i>Culaea inconstans</i> (Kirtland) <i>Camallanus oxycephalus</i> <i>Contracaecum</i> sp. <i>Eustrongylides tubifex</i> <i>Hysterothylacium brachyurum</i> <i>Hysterothylacium</i> sp. Nematoda gen. sp. <i>Spiroxys</i> sp.	Brook Stickleback
<i>Gasterosteus aculeatus</i> Linnaeus <i>Anisakis</i> sp. <i>Ascarophis morrhuae</i> <i>Contracaecum</i> sp. <i>Cosmocephalus obvelatus</i> <i>Eustrongylides</i> sp. <i>Hysterothylacium</i> sp. Nematoda gen. sp. <i>Paracuaria adunca</i> <i>Philonema agubernaculum</i> <i>Pseudoterranova decipiens</i>	Threespine Stickleback
<i>Pungitius pungitius</i> (Linnaeus) <i>Contracaecinea</i> gen. sp. <i>Contracaecum</i> sp. <i>Cosmocephalus obvelatus</i> <i>Paracuaria adunca</i> <i>Raphidascaris acus</i> <i>Raphidascaris</i> sp.	Ninespine Stickleback

Family Syngnathidae

<i>Syngnathus leptorhynchus</i> Girard <i>Anisakis</i> sp. <i>Contracaecum</i> sp. <i>Pseudodelphis oligocotti</i>	Bay Pipefish
---	--------------

ORDER SCORPAENIFORMES

Family Scorpaenidae

<i>Sebastes aleutianus</i> (Jordan & Evermann) <i>Contracaecum</i> sp. <i>Cucullanus</i> sp. <i>Hysterothylacium aduncum</i>	Rougheye Rockfish
<i>Sebastes alutus</i> (Gilbert) <i>Anisakis</i> sp. <i>Ascarophis sebastodis</i> <i>Capillaria</i> sp. <i>Contracaecum</i> sp. <i>Cucullanus</i> sp. <i>Hysterothylacium aduncum</i> <i>Pseudoterranova decipiens</i>	Pacific Ocean Perch
<i>Sebastes babcocki</i> (Thompson) <i>Capillaria</i> sp. <i>Contracaecum</i> sp. <i>Cucullanus</i> sp. <i>Hysterothylacium aduncum</i>	Redbanded Rockfish
<i>Sebastes borealis</i> Barsukov <i>Ascarophis sebastodis</i> <i>Capillaria</i> sp. <i>Contracaecum</i> sp. <i>Cucullanus</i> sp.	Shortraker Rockfish
<i>Sebastes brevispinis</i> (Bean) <i>Anisakis</i> sp. <i>Contracaecum</i> sp. <i>Hysterothylacium aduncum</i>	Silvergray Rockfish
<i>Sebastes caurinus</i> Richardson <i>Ascarophis sebastodis</i> <i>Capillaria</i> sp. <i>Contracaecum</i> sp. <i>Cucullanus elongatus</i> <i>Hysterothylacium aduncum</i>	Copper Rockfish
<i>Sebastes ciliatus</i> (Tilesius) <i>Contracaecum</i> sp. <i>Hysterothylacium aduncum</i>	Dusky Rockfish
<i>Sebastes crameri</i> (Jordan) <i>Contracaecum</i> sp. <i>Cucullanus</i> sp. <i>Hysterothylacium aduncum</i>	Darkblotched Rockfish
<i>Sebastes diploproa</i> (Gilbert) <i>Ascarophis sebastodis</i> <i>Contracaecum</i> sp. <i>Hysterothylacium aduncum</i>	Splitnose Rockfish

<i>Sebastes elongatus</i> Ayres <i>Contracaecum</i> sp.	Greenstriped Rockfish
<i>Sebastes entomelas</i> (Jordan & Gilbert) <i>Contracaecum</i> sp. <i>Hysterothylacium aduncum</i>	Widow Rockfish
<i>Sebastes fasciatus</i> Storer Anisakidae gen. sp. Anisakinae gen. sp. <i>Anisakis simplex</i> <i>Anisakis</i> sp. Contracaecinea gen. sp. <i>Contracaecum</i> sp. <i>Hysterothylacium aduncum</i> <i>Pseudoterranova decipiens</i>	Acadian Redfish
<i>Sebastes flavidus</i> (Ayres) <i>Anisakis</i> sp. <i>Ascarophis sebastodis</i> <i>Capillaria</i> sp. <i>Contracaecum</i> sp. <i>Cucullanus</i> sp. <i>Hysterothylacium aduncum</i> <i>Pseudoterranova decipiens</i> <i>Pseudoterranova</i> sp.	Yellow Rockfish
<i>Sebastes goodei</i> (Eigenmann & Eigenmann) <i>Contracaecum</i> sp.	Chilipepper
<i>Sebastes helvomaculatus</i> Ayres <i>Contracaecum</i> sp. <i>Hysterothylacium aduncum</i>	Rosethorn Rockfish
<i>Sebastes maliger</i> (Jordan & Gilbert) <i>Ascarophis sebastodis</i> <i>Capillaria</i> sp. <i>Contracaecum</i> sp. <i>Cucullanus elongatus</i> <i>Hysterothylacium aduncum</i>	Quillback Rockfish
<i>Sebastes mentella</i> (Travin) Anisakinae gen. sp. <i>Anisakis simplex</i> <i>Anisakis</i> sp. Contracaecinea gen. sp. <i>Contracaecum</i> sp. <i>Hysterothylacium aduncum</i> <i>Pseudoterranova decipiens</i>	Deepwater Redfish
<i>Sebastes nebulosus</i> Ayres	China Rockfish

<i>Ascarophis sebastodis</i>	
<i>Caballeronema wardlei</i>	
<i>Contracaecum</i> sp.	
<i>Cucullanus elongatus</i>	
<i>Hysterothylacium aduncum</i>	
Nematoda gen. sp.	
<i>Sebastes nigrocinctus</i> Ayres	Tiger Rockfish
<i>Capillaria</i> sp.	
<i>Contracaecum</i> sp.	
<i>Sebastes norvegicus</i> (Ascanius)	Golden Redfish
<i>Anisakinae</i> gen. sp.	
<i>Anisakis</i> sp.	
<i>Contracaecum</i> sp.	
<i>Hysterothylacium aduncum</i>	
<i>Pseudoterranova decipiens</i>	
<i>Pseudoterranova</i> sp.	
<i>Sebastes paucispinis</i> Ayres	Bocaccio
<i>Anisakis</i> sp.	
<i>Capillaria</i> sp.	
<i>Contracaecum</i> sp.	
<i>Cucullanus</i> sp.	
<i>Hysterothylacium aduncum</i>	
<i>Sebastes pinniger</i> (Gill)	Canary Rockfish
<i>Anisakis</i> sp.	
<i>Contracaecum</i> sp.	
<i>Hysterothylacium aduncum</i>	
<i>Sebastes polyspinis</i> (Taranetz & Moiseev)	Northern Rockfish
<i>Contracaecum</i> sp.	
<i>Hysterothylacium aduncum</i>	
<i>Sebastes proriger</i> (Jordan & Gilbert)	Redstripe Rockfish
<i>Ascarophis sebastodis</i>	
<i>Contracaecum</i> sp.	
<i>Hysterothylacium aduncum</i>	
<i>Sebastes reedi</i> (Westrheim & Tsuyuki)	Yellowmouth Rockfish
<i>Contracaecum</i> sp.	
<i>Hysterothylacium aduncum</i>	
<i>Sebastes ruberrimus</i> (Cramer)	Yelloweye Rockfish
<i>Ascarophis sebastodis</i>	
<i>Capillaria</i> sp.	
<i>Contracaecum</i> sp.	
<i>Cucullanus elongatus</i>	
<i>Cucullanus</i> sp.	
<i>Hysterothylacium aduncum</i>	

<i>Sebastes variegatus</i> Quast <i>Ascarophis sebastodis</i> <i>Contracaecum</i> sp. <i>Hysterothylacium aduncum</i>	Harlequin Rockfish
<i>Sebastes wilsoni</i> (Gilbert) <i>Contracaecum</i> sp.	Pygmy Rockfish
<i>Sebastes zacentrus</i> (Gilbert) <i>Ascarophis sebastodis</i> <i>Contracaecum</i> sp. <i>Hysterothylacium aduncum</i>	Sharpchin Rockfish
“rockfish” <i>Anisakis simplex</i> <i>Contracaecum</i> sp. <i>Huffmanella</i> sp. <i>Hysterothylacium</i> sp.	

Family Anoplopomatidae

<i>Anoplopoma fimbria</i> (Pallas) <i>Anisakis</i> sp. Nematoda gen. sp. <i>Pseudoterranova decipiens</i> <i>Pseudoterranova</i> sp.	Sablefish
--	-----------

Family Hexagrammidae

<i>Hexagrammos decagrammus</i> (Pallas) <i>Ascarophis</i> sp. Nematoda gen. sp.	Kelp Greenling
<i>Hexagrammos lagocephalus</i> (Pallas) <i>Anisakis</i> sp. <i>Ascarophis sebastodis</i> <i>Capillaria</i> sp. <i>Contracaecum</i> sp.	Rock Greenling
<i>Ophiodon elongatus</i> Girard <i>Anisakis</i> sp. <i>Contracaecum</i> sp. <i>Cucullanus elongatus</i> <i>Hysterothylacium aduncum</i> <i>Hysterothylacium magnum</i> Nematoda gen. sp. <i>Pseudoterranova decipiens</i> <i>Pseudoterranova</i> sp.	Lingcod

Family Rhamphocottidae

<i>Rhamphocottus richardsoni</i> Günther	Grunt Sculpin
[<i>Rhamphocottus richardsonii</i> Girard]	
<i>Ascarophis sebastodis</i>	
<i>Pseudoterranova</i> sp.	

Family Cottidae

<i>Artediellus atlanticus</i> Jordan & Evermann	Atlantic Hookear Sculpin
<i>Pseudoterranova decipiens</i>	

<i>Artedius harringtoni</i> (Starks)	Scalyhead Sculpin
<i>Ascarophis sebastodis</i>	
<i>Capillaria</i> sp.	
<i>Contracaecum</i> sp.	

<i>Artedius lateralis</i> (Girard)	Smoothhead Sculpin
<i>Pseudodelphis oligocotti</i>	

<i>Chitonotus pugetensis</i> (Steindachner)	Roughback Sculpin
<i>Capillaria</i> sp.	
<i>Contracaecum</i> sp.	

<i>Clinocottus acuticeps</i> (Gilbert)	Sharpnose Sculpin
Nematoda gen. sp.	

<i>Cottus aleuticus</i> Gilbert	Coastrange Sculpin
<i>Ascarophis</i> sp.	
<i>Hysterothylacium</i> sp.	

<i>Cottus asper</i> Richardson	Prickly Sculpin
<i>Clavinema mariae</i>	
<i>Eustrongylides</i> sp.	
<i>Pseudocapillaria (Pseudocapillaria) tomentosa</i>	
<i>Rhabdochona cotti</i>	
<i>Salmonema ephemeridarum</i>	

<i>Cottus bairdii</i> Girard	Mottled Sculpin
<i>Camallanus oxycephalus</i>	
<i>Contracaecum</i> sp.	
<i>Raphidascaris acus</i>	
<i>Rhabdochona cotti</i>	

<i>Cottus caeruleomentum</i> Kinzinger, Raesly & Neely	Blue Ridge Sculpin
<i>Rhabdochona cotti</i>	

<i>Cottus cognatus</i> Richardson	Slimy Sculpin
<i>Eustrongylides</i> sp.	
<i>Haplonema</i> sp.	
<i>Raphidascaris acus</i>	
<i>Rhabdochona cotti</i>	

<i>Rhabdochona</i> sp. <i>Spinitectus gracilis</i>	
<i>Hemilepidotus hemilepidotus</i> (Tilesius) <i>Ascarophis sebastodis</i> <i>Capillaria</i> sp.	Red Irish Lord
<i>Icelinus filamentosus</i> Gilbert <i>Contracaecum</i> sp.	Threadfin Sculpin
<i>Jordania zonope</i> Starks <i>Contracaecum</i> sp.	Longfin Sculpin
<i>Leptocottus armatus</i> Girard <i>Anisakis</i> sp. <i>Contracaecum</i> sp. <i>Hysterothylacium magnum</i> <i>Pseudodelphis oligocotti</i>	Pacific Staghorn Sculpin
<i>Myoxocephalus aeneus</i> (Mitchill) <i>Pseudoterranova decipiens</i>	Grubby
<i>Myoxocephalus octodecemspinosus</i> (Mitchill) <i>Anisakis simplex</i> <i>Anisakis</i> sp. <i>Ascarophis extalicola</i> <i>Capillaria</i> (<i>Procapillaria</i>) <i>gracilis</i> <i>Capillaria</i> sp. <i>Contracaecum</i> sp. <i>Contracaecum</i> sp. and/or <i>Phocascaris</i> sp. <i>Pseudoterranova decipiens</i> <i>Pseudoterranova</i> sp.	Longhorn Sculpin
<i>Myoxocephalus polyacanthocephalus</i> (Pallas) <i>Anisakis</i> sp. <i>Ascarophis sebastodis</i> <i>Capillaria</i> sp. <i>Contracaecum</i> sp. <i>Pseudoterranova</i> sp.	Great Sculpin
<i>Myoxocephalus quadricornis</i> (Linnaeus) <i>Pseudoterranova bulbosa</i>	Fourhorn Sculpin
<i>Myoxocephalus scorpius</i> (Linnaeus) <i>Anisakis simplex</i> <i>Contracaecum osculatum</i> <i>Contracaecum</i> sp. and/or <i>Phocascaris</i> sp. <i>Hysterothylacium aduncum</i> Nematoda gen. sp. <i>Pharurus pallasii</i> (EX) <i>Phocascaris</i> sp. <i>Pseudoterranova decipiens</i>	Shorthorn Sculpin

Myoxocephalus thompsonii (Girard)
Cystidicola stigmatura
Raphidascaris acus
 Spirurinae gen. sp.

Deepwater Sculpin

Oligocottus maculosus Girard
Anisakis sp.
Contracaecum sp.
 Nematoda gen. sp.
Pseudodelphis oligocotti

Tidepool Sculpin

Scorpaenichthys marmoratus (Ayres)
Caballeronema wardlei
Capillaria (Procapillaria) margolisi

Cabezón

Triglops murrayi Günther
Pseudoterranova decipiens

Moustache Sculpin

Triglops pingelii Reinhardt
Anisakis sp.
Contracaecum sp.
Pseudoterranova decipiens

Ribbed Sculpin

“sculpin”
Cosmocephalus obvelatus
 Nematoda gen. sp.
Paracuaria adunca
Rhabdochona canadensis

Family Hemitripterae

Blepsias cirrhosus (Pallas)
Anisakis sp.
Contracaecum sp.

Silverspotted Sculpin

Hemitripterus americanus (Gmelin)
Anisakis simplex
Ascarophis arctica
Pseudoterranova decipiens

Sea Raven

Nautichthys oculofasciatus (Girard)
Ascarophis Sebastodis
Ascarophis sp.

Sailfin Sculpin

Family Agonidae

Aspidophoroides monopterygius (Bloch)
Pseudoterranova decipiens

Alligatorfish

Podothecus accipenserinus (Tilesius)

Sturgeon Poacher

Contracaecum sp.
Hysterothylacium aduncum

Family Psychrolutidae

<i>Cottunculus microps</i> Collett <i>Hysterothylacium</i> sp.	Polar Sculpin
<i>Malacocottus kincaidi</i> Gilbert & Thompson <i>Capillaria</i> sp. <i>Contracaecum</i> sp.	Blackfin Sculpin
<i>Psychrolutes sigalutes</i> (Jordan & Starks) <i>Anisakis</i> sp.	Soft Sculpin

Family Cyclopteridae

<i>Cyclopterus lumpus</i> Linnaeus <i>Anisakis</i> sp. <i>Contracaecum</i> sp. and/or <i>Phocascaris</i> sp. <i>Pseudoterranova decipiens</i>	Lumpfish
<i>Eumicrotremus spinosus</i> (Fabricius) <i>Pseudoterranova decipiens</i>	Atlantic Spiny Lumpsucker

Family Liparidae

<i>Liparis dennyi</i> Jordan & Starks <i>Ascarophis filiformis</i>	Marbled Snailfish
---	-------------------

ORDER PERCIFORMES

Family Moronidae

<i>Morone americana</i> (Gmelin) <i>Contracaecum spiculigerum</i> <i>Cucullanellus cotylophora</i> <i>Eustrongylides tubifex</i> <i>Hysterothylacium</i> sp. <i>Spinitectus carolini</i>	White Perch
<i>Morone chrysops</i> (Rafinesque) <i>Camallanus oxycephalus</i> <i>Cucullanellus cotylophora</i> <i>Eustrongylides tubifex</i> Nematoda gen. sp. <i>Raphidascaris acus</i> <i>Raphidascaris</i> sp. <i>Rhabdochona</i> sp.	White Bass

Spinitectus carolini
Spiroxys sp.

Morone saxatilis (Walbaum)
Philometra rubra
Philometra sp.

Striped Bass

Family Centrarchidae

Ambloplites rupestris (Rafinesque)
Anisakis sp.
Camallanus oxycephalus
Capillaria (Capillaroides) catenata
Contracaecum sp.
Cucullanellus cotylophora
Eustrongylides tubifex
Hysterothylacium brachyurum
Hysterothylacium sp.
Nematoda gen. sp.
Rhabdochona cascadilla
Rhabdochona rotundicaudatum
Rhabdochona sp.
Raphidascaris acus
Spinitectus carolini
Spinitectus gracilis
Spiroxys sp.

Rock Bass

Centrarchidae gen.sp.
Cucullanus cotylophora

Lepomis gibbosus (Linnaeus)
Camallanus oxycephalus
Contracaecum sp.
Cucullanellus cotylophora
Dioctophyma renale
Eustrongylides sp.
Eustrongylides tubifex
Hysterothylacium analarum
Hysterothylacium brachyurum
Nematoda gen. sp.
Philometra sp.
Raphidascaris acus
Rhabdochona sp.
Spinitectus carolini
Spinitectus gracilis
Spiroxys sp.

Pumpkinseed

Lepomis macrochirus Rafinesque
Camallanus oxycephalus
Cucullanellus cotylophora
Hysterothylacium sp.
Rhabdochona sp.

Bluegill

Spinitectus carolini

<i>Micropterus dolomieu</i> Lacépède	Smallmouth Bass
<i>Camallanus oxycephalus</i>	
<i>Capillaria</i> sp.	
<i>Contracaecum</i> sp.	
<i>Cucullanellus cotylophora</i>	
<i>Eustrongylides tubifex</i>	
<i>Hysterothylacium brachyurum</i>	
Nematoda gen. sp.	
<i>Philometra</i> sp.	
<i>Raphidascaris acus</i>	
<i>Rhabdochona cascadilla</i>	
<i>Rhabdochona</i> sp.	
<i>Spinitectus carolini</i>	
<i>Spinitectus gracilis</i>	
<i>Spiroxys</i> sp.	

<i>Micropterus salmoides</i> (Lacépède)	Largemouth Bass
<i>Camallanus oxycephalus</i>	
<i>Contracaecum</i> sp.	
<i>Cucullanellus cotylophora</i>	
<i>Dioctophyma</i> sp.	
<i>Hysterothylacium brachyurum</i>	
Nematoda gen. sp.	
<i>Philometra</i> sp.	
<i>Spinitectus carolini</i>	

<i>Pomoxis annularis</i> Rafinesque	White Crappie
<i>Camallanus oxycephalus</i>	
Nematoda gen. sp.	

<i>Pomoxis nigromaculatus</i> (Lesueur)	Black Crappie
<i>Camallanus oxycephalus</i>	
<i>Spinitectus carolini</i>	
<i>Spinitectus gracilis</i>	

Family Percidae

<i>Ammocrypta pellucida</i> (Agassiz)	Eastern Sand Darter
<i>Camallanus oxycephalus</i>	
Nematoda gen. sp.	

<i>Etheostoma blennioides</i> Rafinesque	Greenside Darter
<i>Camallanus oxycephalus</i>	

<i>Etheostoma caeruleum</i> Storer	Rainbow Darter
<i>Rhabdochona rotundicaudatum</i>	
<i>Rhabdochona</i> sp.	

<i>Etheostoma exile</i> (Girard)	Iowa Darter
----------------------------------	-------------

<i>Camallanus oxycephalus</i>	
<i>Hysterothylacium brachyurum</i>	
Nematoda gen. sp.	
<i>Raphidascaris acus</i>	
<i>Rhabdochona cascadilla</i>	
<i>Rhabdochona</i> sp.	
<i>Etheostoma microperca</i> Jordan & Gilbert	Least Darter
<i>Contracaecum</i> sp.	
<i>Etheostoma nigrum</i> Rafinesque	Johnny Darter
<i>Contracaecum</i> sp.	
Nematoda gen. sp.	
<i>Rhabdochona cascadilla</i>	
<i>Spiroxys</i> sp.	
<i>Perca flavescens</i> (Mitchill)	Yellow Perch
<i>Camallanus oxycephalus</i>	
<i>Camallanus</i> sp.	
<i>Contracaecum spiculigerum</i>	
<i>Contracaecum</i> sp.	
<i>Cucullanellus cotylophora</i>	
<i>Cucullanus</i> sp.	
<i>Cystidicola farionis</i>	
<i>Eustrongylides</i> sp.	
<i>Eustrongylides tubifex</i>	
<i>Hysterothylacium brachyurum</i>	
Nematoda gen. sp.	
<i>Philometra cylindracea</i>	
<i>Philometra</i> sp.	
<i>Raphidascaris acus</i>	
<i>Raphidascaris</i> sp.	
<i>Rhabdochona cascadilla</i>	
<i>Rhabdochona ovifilamenta</i>	
<i>Rhabdochona</i> sp.	
<i>Spinitectus carolini</i>	
<i>Spinitectus gracilis</i>	
<i>Spinitectus</i> sp.	
<i>Spiroxys contortus</i>	
<i>Spiroxys</i> sp.	
<i>Percina caprodes</i> (Rafinesque)	Logperch
<i>Camallanus oxycephalus</i>	
<i>Contracaecum</i> sp.	
Nematoda gen. sp.	
<i>Raphidascaris acus</i>	
<i>Spinitectus gracilis</i>	
<i>Percina copelandi</i> (Jordan)	Channel Darter
<i>Camallanus oxycephalus</i>	
<i>Percina maculata</i> (Girard)	Blackside Darter

Camallanus oxycephalus

Sander canadensis (Griffith & Smith)

Sauger

Camallanus oxycephalus

Eustrongylides sp.

Hysterothylacium brachyurum

Raphidascaris acus

Sander vitreus (Mitchill)

Walleye

Camallanus oxycephalus

Contracaecum sp.

Cucullanellus cotylophora

Cystidicola farionis

Eustrongylides sp.

Eustrongylides tubifex

Hysterothylacium brachyurum

Nematoda gen. sp.

Philometra cylindracea

Raphidascaris acus

Raphidascaris sp.

Rhabdochona canadensis

Spinitectus carolini

Spinitectus gracilis

Spinitectus sp.

Family Sciaenidae

Aplodinotus grunniens Rafinesque

Freshwater Drum

Camallanus oxycephalus

Cucullanellus cotylophora

Eustrongylides tubifex

Nematoda gen. sp.

Philometra cylindracea

Philometra sp.

Spinitectus gracilis

Family Embiotocidae

Cymatogaster aggregata Gibbons

Shiner Perch

Anisakis sp.

Contracaecum sp.

Cucullanellus kanabus

Cucullanus sp.

Nematoda gen. sp.

Family Labridae

Tautogolabrus adspersus (Walbaum)

Cunner

Anisakis sp.

Contracaecum sp.
Cucullanellus minutus
Hysterothylacium aduncum
 Nematoda gen. sp.
Phocascaris sp.
Pseudoterranova decipiens
Pseudoterranova sp.

Family Bathymasteridae

<i>Ronquilus jordani</i> (Gilbert)	Northern Ronquil
<i>Anisakis</i> sp.	
<i>Cucullanus</i> sp.	

Family Zoarcidae

<i>Lycodes brevipes</i> Bean	Shortfin Eelpout
<i>Anisakis</i> sp.	
<i>Capillaria</i> sp.	
<i>Lycodes cortezianus</i> (Gilbert)	Bigfin Eelpout
<i>Capillaria</i> sp.	
<i>Contracaecum</i> sp.	
<i>Lycodes esmarkii</i> Collett	Greater Eelpout
<i>Hysterothylacium</i> sp.	
<i>Lycodes lavalaei</i> Vladykov & Tremblay	Newfoundland Eelpout
<i>Ichthyofilaria canadensis</i>	
<i>Lycodes reticulatus</i> Reinhardt	Arctic Eelpout
<i>Pseudoterranova decipiens</i>	
<i>Lycodes vahlii</i> Reinhardt	Checker Eelpout
<i>Ichthyofilaria canadensis</i>	
<i>Pseudoterranova decipiens</i>	
<i>Lycodon mirabilis</i> Goode & Bean	Chevron Scutepout
<i>Hysterothylacium</i> sp.	
<i>Zoarces americanus</i> (Block & Schneider)	Ocean Pout
<i>Anisakis simplex</i>	
<i>Ascarophis arctica</i>	
<i>Contracaecum</i> sp.	
Nematoda gen. sp.	
<i>Pseudoterranova decipiens</i>	
“eelpout”	
<i>Anisakis simplex</i>	
<i>Pseudoterranova decipiens</i>	

Family Stichaeidae

<i>Anoplarchus purpureus</i> Gill	High Cockscomb
<i>Anisakis</i> sp.	
<i>Ascarophis sebastodis</i>	
<i>Clavinema mariae</i>	
<i>Contracaecum</i> sp.	
<i>Pseudoterranova</i> sp.	
<i>Eumesogrammus praecisus</i> (Krøyer)	Fourline Snakeblenny
<i>Pseudoterranova decipiens</i>	
<i>Leptoclinus maculatus</i> (Fries)	Daubed Shanny
<i>Pseudoterranova decipiens</i>	
<i>Lumpenus lumpretaeformis</i> (Walbaum)	Snakeblenny
<i>Pseudoterranova decipiens</i>	
<i>Xiphister atropurpureus</i> (Kittlitz)	Black Prickleback
<i>Clavinema mariae</i>	

Family Cryptacanthodidae

<i>Cryptacanthodes giganteus</i> (Kittlitz)	Giant Wrymouth
<i>Anisakis</i> sp.	
<i>Hysterothylacium aduncum</i>	
<i>Cryptacanthodes maculatus</i> Storer	Wrymouth
<i>Pseudoterranova decipiens</i>	

Family Pholidae

<i>Apodichthys flavidus</i> Girard	Penpoint Gunnel
<i>Anisakis</i> sp.	
<i>Capillaria</i> sp.	
<i>Hysterothylacium magnum</i>	
<i>Pholis gunnellus</i> (Linnaeus)	Rock Gunnel
<i>Ascarophis arctica</i>	
<i>Pholis laeta</i> (Cope)	Crescent Gunnel
<i>Anisakis</i> sp.	
<i>Clavinema mariae</i>	
<i>Contracaecum</i> sp.	
<i>Philometra</i> sp.	
<i>Pseudodelphis oligocotti</i>	
<i>Pholis ornata</i> (Girard)	Saddleback Gunnel
<i>Anisakis</i> sp.	

Clavinema mariae
Contracaecum sp.
Pseudodelphis oligocotti

Rhodymenichthys dolichogaster (Pallas)
Philometridae gen. sp.

Stippled Gunnel

Family Anarhichadidae

Anarhichas lupus Linnaeus
Ascarophis morrhuae
Capillaria (Procapillaria) gracilis
Hysterothylacium aduncum
Pseudoterranova decipiens

Atlantic Wolffish

Family Ammodytidae

Ammodytes dubius Reinhardt
Anisakis simplex
Hysterothylacium aduncum

Northern Sand Lance

Ammodytes hexapterus Pallas
Anisakis sp.
Contracaecum sp.

Pacific Sand Lance

“sand lance”

Pseudoterranova decipiens

Family Icosteidae

Icosteus aenigmaticus Lockington
Anisakis sp.

Ragfish

Family Gobiesocidae

Gobiesox maeandricus (Girard)
Clavinema mariae
Nematoda gen. sp.
Philometridae gen. sp.
Pseudodelphis oligocotti

Northern Clingfish

Family Gobiidae

Rhinogobiops nicholsii (Bean)
Contracaecum sp.

Blackeye Goby

Family Scombridae

<i>Scomber scombrus</i> Linnaeus	Atlantic Mackerel
<i>Anisakis simplex</i>	
<i>Anisakis</i> sp.	
<i>Hysterothylacium aduncum</i>	
<i>Hysterothylacium</i> sp.	
<i>Thunnus alalunga</i> (Bonnaterre)	Albacore
<i>Anisakis</i> sp.	
“mackerel”	
<i>Contracaecum</i> sp.	

Family Xiphiidae

<i>Xiphias gladius</i> Linnaeus	Swordfish
<i>Anisakis simplex</i>	
<i>Hysterothylacium aduncum</i>	
<i>Hysterothylacium corrugatum</i>	
<i>Hysterothylacium incurvum</i>	
<i>Hysterothylacium reliquens</i>	
Nematoda gen. sp.	
<i>Oncophora melanocephala</i>	

Family Stromateidae

<i>Peprilus triacanthus</i> (Peck)	Butterfish
<i>Anisakis simplex</i>	
<i>Pseudoterranova decipiens</i>	

ORDER PLEURONECTIFORMES

Family Scophthalmidae

<i>Scophthalmus aquosus</i> (Mitchill)	Windowpane
<i>Anisakinae</i> gen. sp.	
<i>Anisakis simplex</i>	
<i>Contracaecum</i> sp.	
<i>Pseudoterranova decipiens</i>	
<i>Pseudoterranova</i> sp.	

Family Paralichthyidae

<i>Citharichthys sordidus</i> (Girard)	Pacific Sanddab
<i>Anisakis</i> sp.	
<i>Citharichthys stigmaeus</i> Jordan & Gilbert	Speckled Sanddab

Anisakis sp.
Contracaecum sp.

Family Pleuronectidae

<i>Atheresthes stomias</i> (Jordan & Gilbert) <i>Anisakis simplex</i> <i>Anisakis</i> sp. <i>Hysterothylacium aduncum</i> <i>Pseudoterranova decipiens</i> <i>Pseudoterranova</i> sp. <i>Spirurida</i> gen. sp.	Arrowtooth Flounder
<i>Eopsetta jordani</i> (Lockington) <i>Anisakis</i> sp. <i>Contracaecum</i> sp. <i>Hysterothylacium aduncum</i>	Petrale Sole
<i>Glyptocephalus cynoglossus</i> (Linnaeus) <i>Anisakinae</i> gen. sp. <i>Anisakis simplex</i> <i>Anisakis</i> sp. <i>Ascarophis morrhuae</i> <i>Contracaecum osculatum</i> <i>Contracaecum</i> sp. <i>Contracaecum</i> sp. and/or <i>Phocascaris</i> sp. <i>Hysterothylacium aduncum</i> <i>Nematoda</i> gen. sp. <i>Pseudoterranova decipiens</i> <i>Pseudoterranova</i> sp.	Witch Flounder
<i>Glyptocephalus zachirus</i> Lockington <i>Anisakis</i> sp. <i>Hysterothylacium aduncum</i>	Rex Sole
<i>Hippoglossoides elassodon</i> Jordan & Gilbert <i>Anisakis</i> sp. <i>Contracaecum</i> sp. <i>Hysterothylacium aduncum</i>	Flathead Sole
<i>Hippoglossoides platessoides</i> (Fabricius) <i>Anisakinae</i> gen. sp. <i>Anisakis simplex</i> <i>Anisakis</i> sp. <i>Ascarophis arctica</i> <i>Capillaria (Procapillaria) gracilis</i> <i>Contracaecinea</i> gen. sp. <i>Contracaecum osculatum</i> <i>Contracaecum</i> sp. <i>Contracaecum</i> sp. and/or <i>Phocascaris</i> sp. <i>Hysterothylacium aduncum</i>	American Plaice

Nematoda gen. sp.	
<i>Pharurus pallasii</i> (EX)	
<i>Phocascaris</i> sp.	
<i>Pseudoterranova decipiens</i>	
<i>Pseudoterranova</i> sp.	
<i>Hippoglossus hippoglossus</i> (Linnaeus)	Atlantic Halibut
Anisakidae gen. sp.	
Anisakinae gen. sp.	
<i>Anisakis simplex</i>	
<i>Anisakis</i> sp.	
<i>Capillaria</i> (<i>Procapillaria</i>) <i>gracilis</i>	
<i>Contracaecum osculatum</i>	
<i>Contracaecum</i> sp.	
<i>Cucullanus cirratus</i>	
<i>Hysterothylacium aduncum</i>	
<i>Pseudoterranova bulbosa</i>	
<i>Pseudoterranova decipiens</i>	
<i>Pseudoterranova</i> sp.	
<i>Hippoglossus stenolepis</i> Schmidt	Pacific Halibut
<i>Anisakis simplex</i>	
<i>Ascarophis filiformis</i>	
<i>Capillaria</i> (<i>Procapillaria</i>) <i>margolisi</i>	
<i>Contracaecum</i> sp.	
<i>Cucullanus heterochrous</i>	
<i>Hysterothylacium aduncum</i>	
Nematoda gen. sp.	
<i>Paracapillaria</i> (<i>Paracapillaria</i>) <i>parophrysi</i>	
<i>Pseudoterranova decipiens</i>	
Spiruridae gen. sp.	
<i>Isopsetta isolepis</i> (Lockington)	Butter Sole
<i>Anisakis</i> sp.	
<i>Lepidopsetta bilineata</i> (Ayres)	Rock Sole
<i>Anisakis</i> sp.	
<i>Capillaria</i> sp.	
<i>Clavinema mariae</i>	
<i>Cucullanus</i> sp.	
Philometridae gen. sp.	
<i>Limanda ferrugineus</i> (Storer)	Yellowtail Flounder
Anisakinae gen. sp.	
<i>Anisakis simplex</i>	
<i>Contracaecum</i> sp. and/or <i>Phocascaris</i> sp.	
<i>Contracaecum</i> sp.	
<i>Cucullanus heterochrous</i>	
<i>Hysterothylacium aduncum</i>	
<i>Pseudoterranova decipiens</i>	
<i>Pseudoterranova</i> sp.	

<i>Lyopsetta exilis</i> (Jordan & Gilbert)	Slender Sole
<i>Anisakis</i> sp.	
<i>Contracaecum</i> sp.	
<i>Microstomus pacificus</i> (Lockington)	Dover Sole
<i>Anisakis</i> sp.	
<i>Ascarophis sebastodis</i>	
<i>Cucullanus annulatus</i>	
<i>Hysterothylacium aduncum</i>	
<i>Pseudoterranova decipiens</i>	
Spirurida gen. sp.	
<i>Paraplagusia bilineata</i> (Bloch)	Doublelined Tonguesole
<i>Anisakis</i> sp.	
<i>Capillaria</i> sp.	
<i>Clavinema mariae</i>	
<i>Cucullanus</i> sp.	
Philometridae gen. sp.	
<i>Parophrys vetulus</i> (Girard)	English Sole
<i>Anisakis</i> sp.	
<i>Ascarophis sebastodis</i>	
<i>Capillaria</i> sp.	
<i>Clavinema mariae</i>	
<i>Contracaecum</i> sp.	
<i>Cucullanus annulatus</i>	
<i>Cucullanus</i> sp.	
<i>Hysterothylacium aduncum</i>	
<i>Paracapillaria</i> (<i>Paracapillaria</i>) <i>parophrysi</i>	
<i>Platichthys stellatus</i> (Pallas)	Starry Flounder
<i>Anisakis</i> sp.	
<i>Clavinema mariae</i>	
<i>Contracaecum</i> sp.	
<i>Cucullanus annulatus</i>	
<i>Cucullanus</i> sp.	
Nematoda gen. sp.	
<i>Philometra</i> sp.	
Philometridae gen. sp.	
<i>Pleuronectes putnami</i> (Gill)	Smooth Flounder
Anisakinae gen. sp.	
<i>Contracaecum</i> sp.	
<i>Pseudoterranova</i> sp.	
<i>Psettichthys melanostictus</i> Girard	Sand Sole
<i>Anisakis</i> sp.	
<i>Pseudopleuronectes americanus</i> (Walbaum)	Winter Flounder
Anisakinae gen. sp.	
<i>Anisakis simplex</i>	
<i>Ascarophis arctica</i>	

Contracaecum osculatum
Contracaecum sp.
Contracaecum sp. and/or *Phocascaris* sp.
Cucullanus heterochrous
Hysterothylacium aduncum
Nematoda gen. sp.
Phocascaris sp.
Pseudoterranova decipiens
Pseudoterranova sp.

Reinhardtius hippoglossoides (Walbaum)

Greenland Halibut

Anisakidae gen. sp.
Anisakis simplex
Anisakis sp.
Ascarophis arctica
Ascarophis filiformis
Ascarophis sp.
Contracaecina gen. sp.
Contracaecum sp.
Contracaecum sp. and/or *Phocascaris* sp.
Hysterothylacium aduncum
Nematoda gen. sp.
Phocascaris sp.
Pseudoterranova bulbosa
Pseudoterranova decipiens

"flatfish"

Hysterothylacium sp.

"flounder"

Nematoda gen. sp.

UNSPECIFIED FISH

"fish"

Anisakis simplex
Anisakis sp.
Contracaecum osculatum
Contracaecum sp.
Eustrongylides tubifex
Pseudoterranova decipiens
Pseudoterranova sp.
Spiruridae gen. sp.

Acknowledgements

This project was initiated by the late Dr. Hisao P. Arai, who completed the huge task of accumulating and collating the literature on the nematode parasites of Canadian fishes to 2004. Subsequently, Dr. John W. Smith (JWS) was invited by the late Dr. Michael D. B. Burt to complete this part of the Guide. JWS then compiled descriptions and illustrations of the nematode species, designed the keys, composed the host-parasite, parasite and host lists, and updated the records and literature to February 2016. Latterly, Dr. Donald F. McAlpine (DFM) joined Dr. Burt as Co-Editor of this part of the Guide, working closely with him prior to his untimely death, editing text, locating a publisher, and raising funds to cover costs associated with the production and publication of the manuscript.

JWS offers special thanks to Dr. Mary Needler Arai, Hisao's widow, for her unwavering support throughout this project. He is grateful to Rosalind Hood-Morris for IT support and help with early versions of the Figures. Uta Strelive, a professional illustrator and artist, rendered pen and ink copies of original illustrations. JWS is most grateful to Uta who, working under considerable pressure, produced drawings of invariably superb quality. JWS also thanks his son Robin Smith for much professional help. Robin volunteered many hours of often tedious work refining the figures for the final stages of this part of the Guide's production.

A comprehensive work such as this requires any author to consider a variety of topics where first-hand knowledge is impossible. JWS is grateful therefore to Dr. David I. Gibson (Parasitic Worms Group, Natural History Museum, London, UK), the late Dr. Zbigniew "Bob" Kabata (DFO, Pacific Biological Station, Nanaimo, BC, Canada), Dr. František Moravec (Institute of Parasitology, Academy of Sciences of the Czech Republic, Branišovská, Czech Republic), Dr. Anna J. Phillips (Department of Invertebrate Zoology, Smithsonian Institution, National Museum of Natural History, Washington, DC, USA) and Judith Price (Assistant Collection Manager, Zoology, Canadian Museum of Nature, Ottawa, Ontario, Canada), each of whom willingly shared their particular expertise. Special thanks go to the originally anonymous reviewers, Dr. Anindo Choudhury (St. Norbert College, De Pere, Wisconsin, USA) and Dr. Daniel McLaughlin (Department of Biology, Concordia University, Montreal, Québec, Canada). Dr. Choudhury significantly improved the section on the Phylum Nematoda and its diagnostic features, and the section on nematode collection and processing. Dr. Choudhury also made vital improvements to the keys for *Cystidicola* spp. and *Spinitectus* spp. Dr. McLaughlin helped in many ways. His perceptive comments on the use of molecular methods in nematode systematics in general, and for distinguishing larval nematodes in fish hosts in particular, were especially helpful. This part of the Guide also benefitted enormously from Dr. McLaughlin's meticulous reading of the entire manuscript. The Commonwealth Agricultural Bureau International (CABI) kindly gave permission to include the Glossary of Terms. JWS and DFM are also indebted to Dr. Kerrie Davies (Editor) and the *Zootaxa* production team for their publication expertise. Funding towards the production and publication of this part of the Guide was provided by the New Brunswick Wildlife Trust Fund and the New Brunswick Museum. Funds that ensured this publication is open access were provided by Environment and Climate Change Canada. We are especially grateful to Dr. David J. Marcogliese, of the Science and Technology Branch, Environment and Climate Change Canada, for facilitating the process that led to this funding.

References

- Ackman, R.G. (1976) Volatile ketones and alcohols of codworms (*Terranova decipiens*) from axenic culture and fresh fish muscle. *Journal of the Fisheries Research Board of Canada*, 33, 2819–2821.
<http://dx.doi.org/10.1139/f76-335>
- Ackman, R.G. & Gjelstad, R.T. (1975) Gas chromatographic resolution of isomeric pentanols and pentanones in the identification of volatile alcohols and ketones in codworm *Terranova decipiens* (Krabbe, 1878). *Analytical Biochemistry*, 67, 684–687.
[http://dx.doi.org/10.1016/0003-2697\(75\)90347-4](http://dx.doi.org/10.1016/0003-2697(75)90347-4)
- Adams, A.M., Ton, M.Y., Wekell, M.M., MacKenzie, A.P. & Dong, F.M. (2005) Survival of *Anisakis simplex* in arrowtooth flounder (*Atheresthes stomia* [sic]) during frozen storage. *Journal of Food Protection*, 68, 1441–1446.
- Adams, J.R. (1969) Migration route of invasive juvenile *Philonema oncorhynchi* (Nematoda: Philometridae) in young salmon. *Journal of the Fisheries Research Board of Canada*, 26, 941–946.
<http://dx.doi.org/10.1139/f69-091>
- Adams, J.R. (1974) Development of *Philonema agubernaculum* in the fish host. *Proceedings. 3rd International Congress of Parasitology, 25–31 August 1974, Munich, Federal Republic of Germany*, 1 (Section B7), pp. 482–483.

- Adamson, M.L. & Roth, M. (1990) Prevalence and intensity of *Pseudodelphis oligocotti* n. gen., n. sp. (Dracunculoidea: Guyanemidae) in the tidepool sculpin *Oligocottus maculosus* (Scorpaeniformes: Cottidae). *Journal of Parasitology*, 76, 509–514.
<http://dx.doi.org/10.2307/3282830>
- Adamson, M.L., Clease, D.F. & Margolis, L. (1992) Differentiation of *Philonema* spp. (Nematoda: Philometridae) in British Columbia salmonid fishes using DNA restriction fragment length differences. *Canadian Journal of Fisheries and Aquatic Sciences*, 49, 1650–1656.
<http://dx.doi.org/10.1139/f92-184>
- Aieta, A.E. & Oliveira, K. (2009) Distribution, prevalence, and intensity of the swim bladder parasite *Anguillicola crassus* in New England and eastern Canada. *Diseases of Aquatic Organisms*, 84, 229–235.
<http://dx.doi.org/10.3354/dao02049>
- Anderson, R.C. (1996) Additional observations on the development and transmission of *Truttaedacnitis pybusae* Anderson, 1992 (Seuratoidea: Cucullanidae) of the brook lamprey, *Lampetra appendix* (Dekay, 1842). *Parasite*, 3, 33–37.
<http://dx.doi.org/10.1051/parasite/1996031033>
- Anderson, R.C. (1978) Keys to the Genera of the Superfamily Metastrongyloidea. In: Anderson, R.C., Chabaud, A.G. & Willmott, S. (Eds.), *CIH Keys to the Nematode Parasites of Vertebrates*. No. 5, 40 pp. Commonwealth Agricultural Bureaux, Farnham Royal, Bucks, England.
- Anderson, R.C. (1988) Nematode transmission patterns. *Canadian Journal of Zoology*, 74, 30–45.
<http://dx.doi.org/10.2307/3282477>
- Anderson, R.C. (2000) *Nematode Parasites of Vertebrates: their Development and Transmission*. 2nd Edition. CABI Publishing, CAB International, Oxford and New York, xx + 650 pp.
<http://dx.doi.org/10.1079/9780851994215.0000>
- Anderson, R.C. & Bain, O. (1976) Keys to the Genera of the Order Spirurida. Part 3. Diplotriaenoidea, Aproctoidea and Filarioidea. In: Anderson, R. C., Chabaud, A.G. & Willmott, S. (Eds.), *CIH Keys to the Nematode Parasites of Vertebrates*. No. 3, pp. 59–116. Commonwealth Agricultural Bureaux, Farnham Royal, Bucks, England.
- Anderson, R.C. & Bain, O. (1982) Keys to the Genera of the Superfamilies Rhabditoidea, Dioctophymatoidea, Trichinelloidea and Muspiceoidea. In: Anderson, R.C., Chabaud, A.G. & Willmott, S. (Eds.), *CIH Keys to the Nematode Parasites of Vertebrates*. No. 9, 26 pp. Commonwealth Agricultural Bureaux, Farnham Royal, Bucks, England.
- Anderson, R.C., Chabaud, A.G. & Willmott, S. (Eds.) (1974) General introduction. In: Anderson, R.C., Chabaud, A.G. & Willmott, S. (Eds.), *CIH Keys to the Nematode Parasites of Vertebrates*. No. 1, pp. iii–iv. Commonwealth Agricultural Bureaux, Farnham Royal, Bucks, England.
- Anderson, R.C., Chabaud, A.G. & Willmott, S. (Eds.) (2009) *Keys to the Nematode Parasites of Vertebrates. Archival Volume*. CAB International, Wallingford (UK), 463 pp.
- Anderson, R.C. & Wong, P.L. (1982) The transmission and development of *Paracuaria adunca* (Creplin, 1846) (Nematoda: Acuarioidea) of gulls (Laridae). *Canadian Journal of Zoology*, 60, 3092–3104.
<http://dx.doi.org/10.1139/z82-393>
- Andrews, C.W. & Lear, E. (1954) Appendix No. 14. Arctic char of Labrador. In: W. Templeman. *Fisheries Research Board of Canada Report of the Newfoundland Fisheries Research Station for 1953, with Investigators' Summaries as Appendices*, pp. 49–54.
- Andrews, C.W. & Lear, E. (1956) The biology of the Arctic char (*Salvelinus alpinus* L.) in northern Labrador. *Journal of the Fisheries Research Board of Canada*, 13, 843–860.
<http://dx.doi.org/10.1139/f56-047>
- Anonymous (1978) Report on the environmental studies for the McGregor diversion project. Volume 4 – faunal transfer. Prepared by Redi, Crowther and Partners Ltd for the British Columbia Hydro and Power Authority, British Columbia, 100 pp.
- Anonymous (1981) Kemano Completion Hydroelectric Development – baseline studies. Volume 7. Fish diseases and parasites. Prepared for the Aluminium Company of Canada (1285 West Pender Street, Vancouver) by Envirocon Ltd, Vancouver, British Columbia, 71 pp.
- Anonymous (1984) Environmental studies associated with the proposed Kemano Completion Hydroelectric Development. Volume 7. Fish diseases and parasites, 1979 initial baseline environmental studies. Sections A, B and C. Prepared by Envirocon Ltd, Vancouver, British Columbia, for Aluminium Company of Canada Ltd, Vancouver, British Columbia, 179 pp. [A draft of Section C of this report was circulated in 1983 under the title "Aluminium Company of Canada, Ltd. Kemano Completion Hydroelectric Development, Technical Memorandum 1881/20. Prepared for Aluminum Company of Canada, Ltd by Envirocon Ltd, Vancouver, British Columbia. 53 pp.]
- Anthony, D.D. (1974) Helminth parasites of sturgeon (*Acipenser fulvescens*) from Lake Nipissing, Ontario, Canada. *Proceedings. 3rd International Congress of Parasitology, 25–31 August 1974, Munich, Federal Republic of Germany*, pp. 1642–1643.
- Anthony, D.D. (1977) A new species of *Spinitectus* (Nematoda: Rhabdochoniidae) from Lake Nipissing, Ontario. *Program and Abstracts. 52nd Annual Meeting, American Society of Parasitologists, 14–19 August 1977, Las Vegas, Nevada*, pp. 70–71.
- Anthony, D.D. (1978a) Helminth parasites of lake herring (*Coregonus artedii*) from Lake Nipissing, Ontario. *Program and Abstracts. 53rd Annual Meeting, American Society of Parasitologists, 05–10 November 1978, Chicago, Illinois*, pp. 80–81.

- Anthony, D.D. (1978b) Metazoan parasites of percids from Lake Nipissing, Ontario, Canada. *Proceedings. 4th International Congress of Parasitology, 19–26 August 1978, Warsaw, Poland. Short Communications, Section H*, pp. 39–40.
- Anthony, D.D. (1982) Helminth parasites of freshwater drum (*Aplodinotus grunniens*) from Lake Nipissing, Ontario, Canada. *Proceedings. 5th International Congress of Parasitology, 07–14 August 1982, Toronto, Canada. Molecular and Biochemical Parasitology. Supplement (Parasitology – Their World and Ours)*, p. 438.
- Anthony, D.D. (1983) Metazoan parasites of esocids from Lake Nipissing, Ontario. *Program and Abstracts. 58th Annual Meeting, American Society of Parasitologists, 04–08 December 1983, San Antonio, Texas*, p. 41.
- Anthony, D.D. (1984) Helminth parasites of white bass (*Morone chrysops*) from Lake Nipissing, Ontario. *Program and Abstracts. 59th Annual Meeting, American Society of Parasitologists, 05–09 August 1984. Snowbird, Utah*, p. 27.
- Anthony, D.D. (1985) Helminth parasites of centrarchids from Lake Nipissing, Ontario. *Program and Abstracts. 60th Annual Meeting, American Society of Parasitologists, 04–08 August 1985, Athens, Georgia*, p. 34.
- Anthony, D.D. (1986) Helminth parasites of an exclusively freshwater stock of pink salmon (*Oncorhynchus gorbuscha*) from the Canadian Great Lakes. In: Howell, M.J. (Ed.), *Parasitology – Quo Vadis? Program and Abstracts. 6th International Congress of Parasitology, 25–29 August 1986, Brisbane, Australia. Handbook Supplement*, p. 749.
- Anthony, D.D. (1987) Helminth parasites of burbot (*Lota lota*) from Lake Nipissing, Ontario. *Program and Abstracts. 62nd Annual Meeting, American Society of Parasitologists, 02–05 August 1987, Lincoln, Nebraska*, pp. 42–43.
- Apold, W.O., Woyewoda, A.D., Shaw, S.J. & Bligh, E.G. (1984) Detection and removal of sealworms from Atlantic groundfish. Project Report for Fisheries and Oceans Canada by W.O. Apold (Tavel Ltd, Halifax), A.D. Woyewoda, S. J. Shaw & E.G. Bligh (Canadian Institute of Fisheries Technology, Halifax), 111 pp.
- Appleton, T.E. & Burt, M.D.B. (1990) Differentiation of populations of the sealworm *Pseudoterranova decipiens* (Nematoda: Anisakidae), using isoelectric focusing. Program and Abstracts. 29th Annual Meeting, Canadian Society of Zoologists, Simon Fraser University, 02–05 May 1990. *Bulletin of the Canadian Society of Zoologists*, 21, p. 22.
- Appleton, T.E. & Burt, M.D.B. (1991) Biochemical characterization of third-stage larval sealworm, *Pseudoterranova decipiens* (Nematoda: Anisakidae), in Canadian Atlantic waters using isoelectric focusing of soluble proteins. *Canadian Journal of Fisheries and Aquatic Sciences*, 48, 1800–1803.
<http://dx.doi.org/10.1139/f91-212>
- Appy, R.G. (1981) Species of *Ascarophis* van Beneden, 1870 (Nematoda: Cystidicolidae) in North Atlantic fishes. *Canadian Journal of Zoology*, 59, 2193–2205.
<http://dx.doi.org/10.1139/z81-297>
- Appy, R.G. & Anderson, R.C. (1982) The genus *Capillospirura* Skrjabin, 1924 (Nematoda: Cystidicolidae) of sturgeons. *Canadian Journal of Zoology*, 60, 194–202.
<http://dx.doi.org/10.1139/z82-027>
- Appy, R.G., Anderson, R.C. & Khan, R.A. (1985) *Ichthyofilaria canadensis* n. sp. (Nematoda: Dracunculoidea) from eelpouts (*Lycodes* spp.). *Canadian Journal of Zoology*, 63, 1590–1592.
<http://dx.doi.org/10.1139/z85-235>
- Appy, R.G. & Burt, M.D.B. (1982) Metazoan parasites of cod, *Gadus morhua* L., in Canadian Atlantic waters. *Canadian Journal of Zoology*, 60, 1573–1579.
<http://dx.doi.org/10.1139/z82-207>
- Appy, R.G. & Dadswell, M.J. (1978) Parasites of *Acipenser brevirostrum* LeSueur and *Acipenser oxyrinchus* Mitchill (Osteichthyes: Acipenseridae) in the Saint John River estuary, N. B., with a description of *Caballeronema pseudoargumentosus* sp. n. (Nematoda: Spirurida). *Canadian Journal of Zoology*, 56, 1382–1391.
<http://dx.doi.org/10.1139/z78-191>
- Appy, R.G. & Dadswell, M.J. (1980) Transmission of *Caballeronema pseudoargumentosus* (Nematoda: Cystidicolidae). *Program and Abstracts. 55th Annual Meeting, American Society of Parasitologists, 04–08 August 1980, Berkeley, California*, pp. 61–62.
- Appy, R.G. & Dadswell, M.J. (1983) Transmission and development of *Capillospirura pseudoargumentosa* (Appy & Dadswell, 1978) (Nematoda: Cystidicolidae). *Canadian Journal of Zoology*, 61, 848–859.
<http://dx.doi.org/10.1139/z83-111>
- Arai, H.P. (1964) Studies on host-specificity of fish parasites. In: L. Margolis. *Parasitism and Disease. Progress Report, Pacific Biological Station, Nanaimo*: p. G–4/G–5. (Mimeographed)
- Arai, H.P. (1967a) A preliminary report on a study of the parasites of Burke Channel, British Columbia. *Fisheries Research Board of Canada Manuscript Reports*, 925, 26 pp.
- Arai, H.P. (1967b) Ecological specificity of parasites of embiotocid fishes. *Journal of the Fisheries Research Board of Canada*, 24, 2161–2168.
<http://dx.doi.org/10.1139/f67-176>
- Arai, H.P. (1969) Preliminary report on the parasites of certain marine fishes of British Columbia. *Journal of the Fisheries Research Board of Canada*, 26, 2319–2337.
<http://dx.doi.org/10.1139/f69-226>
- Arai, H.P. (1986) Seasonal changes and latitudinal differences in the parasite fauna of *Cymatogaster aggregata*. In: Howell, M.J. (Ed.). *Parasitology – Quo Vadis? Program and Abstracts. 6th International Congress of Parasitology, 25–29 August 1986, Brisbane, Australia*, p. 85.

- Arai, H.P. (1989) Acanthocephala, pp. 1–90. In: L. Margolis & Z. Kabata (Eds.). Guide to the Parasites of Fishes of Canada. Part III. *Canadian Special Publication of Fisheries and Aquatic Sciences*, 107, 95 pp.
<http://dx.doi.org/10.2307/3282617>
- Arai, H.P. & Arthur, J.R. (1977) Allometric growth in *Cucullanellus kanabus* Walder and Arai (Nematoda: Cucullanidae). *Excerta Parasitologica en Memoria del Doctor Eduardo Caballero y Caballero*. Universidad Nacional Autonoma de Mexico. *Instituto de Biologia, Publicaciones Especiales*, 4, 377–383.
- Arai, H.P. & Kussat, R.H. (1967) Observations on the distribution of parasites of certain catostomid fishes of the Bow River, Alberta. *Canadian Journal of Zoology*, 45, 1287–1290.
<http://dx.doi.org/10.1139/z67-140>
- Arai, H.P. & Mudry, D.R. (1983) Protozoan and metazoan parasites of fishes from the headwaters of the Parsnip and McGregor Rivers, British Columbia: a study of possible parasite transfaunations. *Canadian Journal of Fisheries and Aquatic Sciences*, 40, 1676–1684.
<http://dx.doi.org/10.1139/f83-194>
- Arai, H.P., Kabata, Z. & Noakes, D. (1988) Studies on seasonal changes and latitudinal differences in the metazoan fauna of the shiner perch, *Cymatogaster aggregata*, along the west coast of North America. *Canadian Journal of Zoology*, 66, 1514–1517.
<http://dx.doi.org/10.1139/z88-222>
- Arai, M.N. (1989) Cnidaria, pp. 91–95. In: L. Margolis & Z. Kabata (Eds.). Guide to the Parasites of Fishes of Canada. Part III. *Canadian Special Publication of Fisheries and Aquatic Sciences*, 107, 95 pp.
<http://dx.doi.org/10.2307/3282617>
- Arthur, J.R. (1978) Studies on the parasites of Pacific herring (*Clupea harengus pallasii*) in North American waters. Ph. D. Dissertation, Department of Biology, University of Calgary, Alberta, 206 pp.
- Arthur, J.R. (1983) A preliminary analysis of the discreteness of stocks of walleye pollock (*Theragra chalcogramma*) from the northeastern Pacific Ocean off Canada based on their parasites. *Canadian Technical Report of Fisheries and Aquatic Sciences*, No. 1184, 15 pp.
- Arthur, J.R. (1984) A survey of the parasites of walleye pollock (*Theragra chalcogramma*) from the northeastern Pacific Ocean off Canada and a zoogeographical analysis of the parasite fauna of this fish throughout its range. *Canadian Journal of Zoology*, 62, 675–684.
<http://dx.doi.org/10.1139/z84-099>;
- Arthur, J.R. & Albert, E. (1992a) Parasites of Greenland halibut (*Reinhardtius hippoglossoides*) from the Atlantic Ocean off Canada. *Program and Abstracts. 31st Annual Meeting, Canadian Society of Zoologists, St Francis Xavier University, 13–17 May 1992. Bulletin of the Canadian Society of Zoology*, 23, p. 26.
- Arthur, J.R. & Albert, E. (1992b) Parasites as biological tags for Greenland halibut (*Reinhardtius hippoglossoides*) from the Atlantic Ocean off Canada. *Program and Abstracts. 67th Annual Meeting, American Society of Parasitologists, Philadelphia, Pennsylvania, 04–08 August 1992*, p. 63.
- Arthur, J.R. & Albert, E. (1993) Use of parasites for separating stocks of Greenland halibut (*Reinhardtius hippoglossoides*) in the Canadian northwest Atlantic. *Canadian Journal of Fisheries and Aquatic Sciences*, 50, 2175–2181.
<http://dx.doi.org/10.1139/f93-243>
- Arthur, J.R. & Albert, E. (1994) A survey of the parasites of Greenland halibut (*Reinhardtius hippoglossoides*) caught off Atlantic Canada, with notes on their zoogeography in this fish. *Canadian Journal of Zoology*, 72, 756–778.
<http://dx.doi.org/10.1139/z94-103>
- Arthur, J.R., Albert, E. & Boily, F. (1995) Parasites of capelin (*Mallotus villosus*) in the St. Lawrence estuary and gulf. *Canadian Journal of Fisheries and Aquatic Sciences*, 52 (Suppl. 1), 246–253.
<http://dx.doi.org/10.1139/f95-532>
- Arthur, J.R. & Arai, H.P. (1984) Annotated checklist and bibliography of parasites of herring (*Clupea harengus* L.). *Canadian Special Publication of Fisheries and Aquatic Sciences*, 70, 26 pp.
- Arthur, J.R. & Arai, H.P. (1979) A preliminary analysis of the value of parasites as biological indicators for stocks of Pacific herring. *Program and Abstracts. 18th Annual Meeting, Canadian Society of Zoologists, Quebec City, Quebec, 13–16 May 1979*, p. 97.
- Arthur, J.R. & Arai, H.P. (1980a) Studies on the parasites of Pacific herring (*Clupea harengus pallasii* Valenciennes): survey results. *Canadian Journal of Zoology*, 58, 64–70.
<http://dx.doi.org/10.1139/z80-008>
- Arthur, J.R. & Arai, H.P. (1980b) Studies on the parasites of Pacific herring (*Clupea harengus pallasii* Valenciennes): a preliminary evaluation of parasites as indicators of geographical origin for spawning herring. *Canadian Journal of Zoology*, 58, 521–527.
<http://dx.doi.org/10.1139/z80-072>
- Arthur, J.R. & Margolis, L. (1975) Revision of the genus *Haplonema* Ward and Magath, 1917 (Nematoda: Seuratoidea). *Canadian Journal of Zoology*, 53, 736–747.
<http://dx.doi.org/10.1139/z75-088>
- Arthur, J.R., Margolis, L. & Arai, H.P. (1976) Parasites of fishes of Aishihik and Stevens Lakes, Yukon Territory, and potential consequences of their interlake transfer through a proposed water diversion for hydroelectrical purposes. *Journal of the*

- Fisheries Research Board of Canada*, 33, 2489–2499.
<http://dx.doi.org/10.1139/f76-294>
- Arthur, J.R., Margolis, L., Whitaker, D.J. & McDonald, T.E. (1982) A quantitative study of economically important parasites of walleye pollock (*Theragra chalcogramma*) from British Columbian waters and effects of postmortem handling on their abundance in the musculature. *Canadian Journal of Fisheries and Aquatic Sciences*, 39, 710–726.
<http://dx.doi.org/10.1139/f82-100>
- Baer, H.G. (1953) Appendix 38. Cod-worm investigation—life history. In: Needler, A.W.H. (Ed.). *Fisheries Research of Canada, Report of the Atlantic Biological Station for 1953*, pp. 71–72.
- Baggs, E.M. & Cowan, G.I. McT. (1989) The onset of parasitism of young-of-the-year brook charr, *Salvelinus fontinalis* (Mitchill), in Big Northern Pond, Avalon Peninsula, Newfoundland, Canada. *Journal of Fish Biology*, 35, 317–319.
<http://dx.doi.org/10.1111/j.1095-8649.1989.tb02983.x>
- Bailey, R.E. & Margolis, L. (1987) Comparison of parasite fauna of juvenile sockeye salmon (*Oncorhynchus nerka*) from southern British Columbian and Washington State lakes. *Canadian Journal of Zoology*, 65, 420–431.
<http://dx.doi.org/10.1139/z87-063>
- Bailey, R.E., Margolis, L. & Groot, C. (1988) Estimating stock composition of migrating juvenile Fraser River (British Columbia) sockeye salmon, *Oncorhynchus nerka*, using parasites as natural tags. *Canadian Journal of Fisheries and Aquatic Sciences*, 45, 586–591.
<http://dx.doi.org/10.1139/f88-071>
- Bajkov, A. (1930) A study of the whitefish (*Coregonus clupeaformis*) in Manitoban lakes. *Contributions to Canadian Biology and Fisheries*, 5, 441–455.
<http://dx.doi.org/10.1139/f30-015>
- Baker, M.R. (1979) Redescription of *Camallanus ancylodirus* Ward and Magath 1916 (Nematoda: Camallanidae) from freshwater fishes of North America. *Journal of Parasitology*, 65, 389–392.
<http://dx.doi.org/10.2307/3280280>
- Baker, M.R. (1984a) Redescription of *Dichelyne (Cucullanellus) cotylophora* (Ward & Magath) (Nematoda: Cucullanidae) parasitic in freshwater fishes of eastern North America. *Canadian Journal of Zoology*, 62, 2053–2061.
<http://dx.doi.org/10.1139/z84-300>
- Baker, M.R. (1984b) On the biology of *Dichelyne (Cucullanellus) cotylophora* (Ward & Magath, 1917) (Nematoda, Cucullanidae) in perch (*Perca flavescens*) from Lake Erie, Ontario. *Canadian Journal of Zoology*, 62, 2062–2073.
<http://dx.doi.org/10.1139/z84-301>
- Baldwin, R.E. & Goater, C.P. (2003) Circulation of parasites among fishes from lakes in the Caribou Mountains, Alberta, Canada. *Journal of Parasitology*, 89, 215–225.
[http://dx.doi.org/10.1645/0022-3395\(2003\)089\[0215:copaff\]2.0.co;2](http://dx.doi.org/10.1645/0022-3395(2003)089[0215:copaff]2.0.co;2)
- Bangham, R.V. (1941) Parasites of fish of Algonquin Park lakes. *Transactions of the American Fisheries Society*, 70, 161–171.
[http://dx.doi.org/10.1577/1548-8659\(1940\)70\[161:pofaop\]2.0.co;2](http://dx.doi.org/10.1577/1548-8659(1940)70[161:pofaop]2.0.co;2)
- Bangham, R.V. (1951) Parasite records by location in 1951: Manitoulin Island and surrounding waters. University of Toronto, Ontario Fisheries Research Laboratory Report, 27 pp.
- Bangham, R.V. (1955) Studies on fish parasites of Lake Huron and Manitoulin Island. *American Midland Naturalist*, 53, 184–194.
<http://dx.doi.org/10.2307/2422308>
- Bangham, R.V. & Adams, J.R. (1954) A survey of the parasites of freshwater fishes from the mainland of British Columbia. *Journal of the Fisheries Research Board of Canada*, 11, 673–708.
<http://dx.doi.org/10.1139/f54-043>
- Bangham, R.V. & Hunter, G.W. III. (1939) Studies on fish parasites of Lake Erie. Distribution studies. *Zoologica (New York)*, 24, 385–444.
- Bangham, R.V. & Venard, C.E. (1946) Parasites of fish of Algonquin Park lakes. II. Distribution studies. *University of Toronto Studies in Biology Series*, 53, 31–46. (Ontario Fisheries Research Laboratory Publication. No. 65.)
- Barker, D.B., Khan, R.A. & Hooper, R. (1994) Bioindicators of stress in winter flounder, *Pleuronectes americanus*, captured adjacent to a pulp and paper mill in St George's Bay, Newfoundland. *Canadian Journal of Fisheries and Aquatic Sciences*, 51, 2203–2209.
<http://dx.doi.org/10.1139/f94-222>
- Barker, D.E., Marcogliese, D.J. & Cone, D.K. (1996) On the distribution and abundance of eel parasites in Nova Scotia: local versus regional patterns. *Journal of Parasitology*, 82, 697–701.
<http://dx.doi.org/10.2307/3283877>
- Barracough, W.E. (1967) Data record. Number, size and food of larval and juvenile fish caught with an Isaac-Kidd trawl in the surface waters of the Strait of Georgia. April 25–29, 1966. *Fisheries Research Board of Canada Manuscript Report Series*, No. 926, 79 pp.
- Bartlett, C.M. (1996) Morphogenesis of *Contracaecum rudolphii* (Nematoda: Ascaridoidea), a parasite of fish-eating birds, in its copepod precursor and fish intermediate hosts. *Parasite*, 4, 367–376.
- Bartlett, C.M. & Anderson, R. C. (1985) Larval nematodes (Ascaridida and Spirurida) in the aquatic snail, *Lymnaea stagnalis*. *Journal of Invertebrate Pathology*, 46, 153–159.

[http://dx.doi.org/10.1016/0022-2011\(85\)90143-0](http://dx.doi.org/10.1016/0022-2011(85)90143-0)

- Bashirullah, A.K.M. (1983) Survival and development of *Philonema oncorhynchi* (Nematoda: Philometridae) in different recipient fish hosts. *Rivista Parassitologia*, 44, 489–496.
- Bashirullah, A.K.M. & Adams, J.R. (1966) Effect of pituitary extract on maturation of *Philonema oncorhynchi*. *Program and Abstracts. 41st Annual Meeting, American Society of Parasitologists, 29 October–04 November 1966*, San Juan, Puerto Rico, p. 44.
- Bashirullah, A.K.M. & Adams, J.R. (1983) *Philonema oncorhynchi*: effect of hormones on maturation in anadromous sockeye, *Oncorhynchus nerka*. *International Journal for Parasitology*, 13, 261–265.
[http://dx.doi.org/10.1016/0020-7519\(83\)90037-1](http://dx.doi.org/10.1016/0020-7519(83)90037-1)
- Baudin-Laurencin, F. (1971) *Oncophora melanocephala* (Rud. 1819) n. comb., nématode Camallanidae, parasite du thon albacore *Neothunnus albacares*. *Bulletin du Muséum National d'Histoire Naturelle Paris*, 2nd series, Vol. 42, No. 5, 1970, 984–988.
- Bell, D.A. & Beverley-Burton, M. (1980) Prevalence and intensity of *Capillaria catostomi* (Nematoda: Trichuroidea) in white sucker (*Catostomus commersoni*) in southern Lake Huron, Canada. *Environmental Biology of Fishes*, 5, 267–271.
<http://dx.doi.org/10.1007/bf00005362>
- Bell, D.A. & Beverley-Burton, M. (1981) The taxonomy of *Capillaria* spp. (Nematoda: Trichuroidea) in North American freshwater fishes. *Systematic Parasitology*, 2, 157–169.
<http://dx.doi.org/10.1007/bf00009905>
- Bell, G.R. & Hoskins, G.E. (1971) Investigations of wild fish mortalities in B.C., 1969–1970. *Fisheries Research Board of Canada Technical Report*, No. 245, 19 pp.
- Bell, G.R. & Margolis, L. (1976) The fish health program and the occurrence of fish diseases in the Pacific region of Canada. *Fish Pathology*, 10, 115–122.
<http://dx.doi.org/10.3147/jsfp.10.115>
- Bennett, S.N. & Adamson, M.L. (1994) Patterns of parasite distribution in eelgrass bed fishes. *Program and Abstracts. 69th Annual Meeting, American Society of Parasitologists, 09–13 August 1994*. Fort Collins, Colorado, p. 63.
- Bennett, S.N. & Adamson, M.L. (2004) Prevalence, intensity, and differential development of *Pseudodelphis oligocotti* (Nematoda: Dracunculoidea) in sympatric fish hosts of the northeastern Pacific Ocean. *Journal of Parasitology*, 90, 678–684.
<http://dx.doi.org/10.1645/ge-244r>
- Bennett, S.N., Adamson, M.L. & Margolis, L. (1998) Long-term changes in parasites of sockeye salmon (*Oncorhynchus nerka*) smolts. *Canadian Journal of Fisheries and Aquatic Sciences*, 55, 977–996.
<http://dx.doi.org/10.1139/f97-295>
- Berland, B. (1961) Nematodes from some Norwegian marine fishes. *Sarsia*, 2, 1–50.
<http://dx.doi.org/10.1080/00364827.1961.10410245>
- Berland, B. (1963) *Phocascaris cystophorae* sp. nov. (Nematoda) from the hooded seal, with an emendation of the genus. *Årbok for Universitetet i Bergen. Matematisk–Naturvitenskapelig Serie*, 17, 21 pp.
- Berland, B. (1970) On the morphology of the head in four species of the Cucullanidae (Nematoda). *Sarsia*, 43, 15–64.
<http://dx.doi.org/10.1080/00364827.1970.10411168>
- Berland, B. (1981) An anisakid larva with aberrant appendix. *Sarsia*, 66, 316–317.
<http://dx.doi.org/10.1080/00364827.1981.10414550>
- Berland, B. (1983) Redescription of *Cucullanus elongatus* Smedley, 1933 (Nematoda: Seuratoidea) from the lingcod *Ophiodon elongatus* Girard, 1854 from the Pacific coast of Canada. *Canadian Journal of Zoology*, 61, 385–395.
<http://dx.doi.org/10.1139/z83-051>
- Berland, B., Bratney, J., D'Amelio, S., Mattiucci, S., Nascetti, G., Orecchia, P., Paggi, L. & Smith, J.W. (1989) Multilocus electrophoresis in the study of marine ascaridoid nematodes: species, hosts and geographic distribution in the North Atlantic. *Program and Abstracts. 64th Annual Meeting, American Society of Parasitologists, 06–10 August 1989*. University of British Columbia, Vancouver, British Columbia, Canada, p. 71.
- Beverley-Burton, M. (1978a) Metazoan parasites of Arctic char (*Salvelinus alpinus* L.) in a high Arctic landlocked lake in Canada. *Canadian Journal of Zoology*, 56, 365–368.
<http://dx.doi.org/10.1139/z78-052>
- Beverley-Burton, M. (1978b) Population genetics of *Anisakis simplex* (Nematoda: Ascaridoidea) in the Atlantic salmon (*Salmo salar*) and their use as biological indicators of host stocks. *Environmental Biology of Fishes*, 3, 369–377.
<http://dx.doi.org/10.1007/bf00000529>
- Beverley-Burton, M. (1984) Monogenea and Turbellaria, pp. 5–209. In: Margolis, L. & Kabata, Z. (Eds.), Guide to the Parasites of Fishes of Canada. Part I. *Canadian Special Publication of Fisheries and Aquatic Sciences*, 107, 209 pp.
<http://dx.doi.org/10.1017/s0022149x00008087>
- Beverley-Burton, M., Nyman, O.L. & Pippy, J.H.C. (1977) The morphology, and some observations on the population genetics of *Anisakis simplex* larvae (Nematoda: Ascaridata) from fishes of the North Atlantic. *Journal of the Fisheries Research Board of Canada*, 34, 105–112.
<http://dx.doi.org/10.1139/f77-012>
- Beverley-Burton, M. & Pippy, J.H.C. (1977) Morphometric variation among larval nematodes (Nematoda: Ascaridoidea) from

- fishes of the North Atlantic and their use as biological indicators of host stocks. *Environmental Biology of Fishes*, 2, 309–314.
<http://dx.doi.org/10.1007/bf00005998>
- Beverley-Burton, M. & Pippy, J.H.C. (1978) Distribution, prevalence and mean numbers of larval *Anisakis simplex* (Nematoda: Ascaridoidea) in Atlantic salmon, *Salmo salar* L. and their use as biological indicators of host stocks. *Environmental Biology of Fishes*, 3, 211–222.
<http://dx.doi.org/10.1007/bf00691945>
- Bishop, Y.M.M. & Margolis, L. (1955) A statistical examination of *Anisakis* larvae (Nematoda) in herring (*Clupea pallasii*) of the British Columbia coast. *Journal of the Fisheries Research Board of Canada*, 12, 571–592.
<http://dx.doi.org/10.1139/f55-030>
- Black, E.A. (1984) The stomach contents of the Pacific cod, sablefish and lingcod in the Queen Charlotte Straits 1978–1981. British Columbia Ministry of Fisheries, Fisheries Branch, Fisheries Data Report, No. 7, 273 pp.
- Black, E.A. (1985) The stomach contents of Pacific herring in the Queen Charlotte Straits 1978–1981. British Columbia Ministry of Fisheries, Fisheries Branch, Fisheries Data Report, No. 8, 142 pp.
- Black, E.A. & Low, C.J. (1985) The stomach contents of Salmonidae caught in the Queen Charlotte Straits 1978–1981. British Columbia Ministry of Fisheries, Fisheries Branch, Fisheries Data Report, No. 9, 481 pp.
- Black, G.A. (1981a) Metazoan parasites as indicators of movements of anadromous brook charr (*Salvelinus fontinalis*) to sea. *Canadian Journal of Zoology*, 59, 1892–1896.
<http://dx.doi.org/10.1139/z81-257>
- Black, G.A. (1981b) Population biology of the swim-bladder nematode, *Cystidicola cristivomeri*, in charr, *Salvelinus* spp. Program and Abstracts. 20th Annual Meeting, Canadian Society of Zoologists, University of Waterloo, 10–13 May 1981. *Bulletin of the Canadian Society of Zoologists*, 12, p.33.
- Black, G.A. (1983a) Taxonomy of a swimbladder nematode, *Cystidicola stigmatura* (Leidy) and evidence of its decline in the Great Lakes. *Canadian Journal of Fisheries and Aquatic Sciences*, 40, 643–647.
<http://dx.doi.org/10.1139/f83-085>
- Black, G.A. (1983b) Origin, distribution, and postglacial dispersal of a swimbladder nematode, *Cystidicola stigmatura*. *Canadian Journal of Fisheries and Aquatic Sciences*, 40, 1244–1253.
<http://dx.doi.org/10.1139/f83-141>
- Black, G.A. (1983c) *Cystidicola farionis* (Nematoda) as an indicator of lake trout (*Salvelinus namaycush*) of Bering ancestry. *Canadian Journal of Fisheries and Aquatic Sciences*, 40, 2034–2040.
<http://dx.doi.org/10.1139/f83-234>
- Black, G.A. (1984a) Swimbladder lesions in lake trout (*Salvelinus namaycush*) associated with mature *Cystidicola stigmatura* (Nematoda). *Journal of Parasitology*, 70, 441–443.
<http://dx.doi.org/10.2307/3281580>
- Black, G.A. (1984b) Morphometrics of *Cystidicola stigmatura* (Nematoda) in relation to its glacial history. *Journal of Parasitology*, 70, 967–974.
<http://dx.doi.org/10.2307/3281649>
- Black, G.A. (1985) Reproductive output and population biology of *Cystidicola stigmatura* (Leidy) (Nematoda) in Arctic char, *Salvelinus alpinus* (L.) (Salmonidae). *Canadian Journal of Zoology*, 63, 617–622.
<http://dx.doi.org/10.1139/z85-090>
- Black, G.A. & Anderson, R.C. (1982) Zoogeography of *Cystidicola cristivomeri* in char, *Salvelinus* spp. Abstracts. 5th International Congress of Parasitology, 07–14 August 1982, Toronto, Canada. *Molecular and Biochemical Parasitology. Supplement (Parasites – Their World and Ours)*, pp. 351–352.
- Black, G.A. & Lankester, M.W. (1980) Migration and development of swim-bladder nematodes, *Cystidicola* spp. (Habronematoidea), in their definitive hosts. *Canadian Journal of Zoology*, 58, 1997–2005.
<http://dx.doi.org/10.1139/z80-275>
- Black, G.A. & Lankester, M.W. (1981a) The transmission, life span, and population biology of *Cystidicola cristivomeri* White, 1941 (Nematoda: Habronematoidea) in char, *Salvelinus* spp. *Canadian Journal of Zoology*, 59, 498–509.
<http://dx.doi.org/10.1139/z81-073>
- Black, G.A. & Lankester, M.W. (1981b) The biology and parasites of deepwater sculpin, *Myoxocephalus thompsonii* (Girard), in Burchell Lake, Ontario. *Canadian Journal of Zoology*, 59, 1454–1457.
<http://dx.doi.org/10.1139/z81-196>
- Black, G.A. & Lankester, M.W. (1984) Distribution and biology of swimbladder nematodes, *Cystidicola* spp. (Habronematoidea), in charr, *Salvelinus* spp. In: L. Johnson & B. Burns (Eds.). *Biology of the Arctic Charr*. Proceedings of the International Symposium on Arctic Charr. May, 1981, Winnipeg, Manitoba. University of Manitoba Press, Winnipeg, Manitoba, pp. 413–429.
- Black, W.F. (1957) The feeding of nematode-infested mysids to cod. *Fisheries Research Board of Canada Manuscript Reports (Biology)*, No. 627, 11 pp.
- Blair, J.E., Ikeo, K., Gojobori, T. & Hedges, S.B. (2002) The evolutionary position of nematodes. *BMC Evolutionary Biology*, 2, 7 pp.
<http://dx.doi.org/10.1186/1471-2148-2-7>

- Blaxter, M. L., De Ley, P., Garey, J. R., Liu, L. X., Scheldeman, P., Vierstraete, A., Vanfleteren, J.R., Mackey, L.Y., Dorris, M., Frisse, L.M., Vida, J.T. & Thomas, W.K. (1998) A molecular evolutionary framework for the phylum Nematoda. *Nature*, 392, 71–75.
<http://dx.doi.org/10.1038/32160>
- Blaycock, R.B. (1996) The parasites of Pacific halibut, *Hippoglossus stenolepis*, in the northeastern Pacific: ecological patterns in time and space. Ph. D. Dissertation. Department of Biological Sciences, University of Alberta, Edmonton, Alberta, 156 pp.
- Blaycock, R.B., Holmes, J.C. & Margolis, L. (1998a) The parasites of Pacific halibut (*Hippoglossus stenolepis*) in the eastern North Pacific: host-level influences. *Canadian Journal of Zoology*, 76, 536–547.
<http://dx.doi.org/10.1139/z97-214>
- Blaycock, R.B., Margolis, L. & Holmes, J.C. (1998b) Zoogeography of the parasites of Pacific halibut (*Hippoglossus stenolepis*) in the northeast Pacific. *Canadian Journal of Zoology*, 76, 2262–2273.
<http://dx.doi.org/10.1139/z98-172>
- Blaycock, R.B., Margolis, L. & Holmes, J.C. (2003) The use of parasites in discriminating stocks of Pacific halibut (*Hippoglossus stenolepis*) in the northeast Pacific. *Fisheries Bulletin*, 101, 1–9.
<http://dx.doi.org/10.1139/z98-172>
- Boghen, A.D. & Davey, K.G. (1975) A pseudocoelomocyte in the parasitic nematode *Phocanema decipiens*. *Transactions of the American Microscopical Society*, 94, 203–210.
<http://dx.doi.org/10.2307/3224981>
- Boily, F. & Marcogliese, D.J. (1995) Geographical variations in abundance of larval anisakine nematodes in Atlantic cod (*Gadus morhua*) and American plaice (*Hippoglossoides platessoides*) from the Gulf of St. Lawrence. *Canadian Journal of Fisheries and Aquatic Sciences*, 52 (Suppl. 1), 105–115.
<http://dx.doi.org/10.1139/f95-516>
- Boje, J., Riget, F. & Koie, M. (1997) Helminth parasites as biological tags in population studies of Greenland halibut (*Reinhardtius hippoglossoides* (Walbaum)), in the north–west Atlantic. *ICES Journal of Marine Science*, 54, 886–895.
<http://dx.doi.org/10.1006/jmsc.1997.0214>
- Bouillon, D.R. & Dempson, J.B. (1989) Metazoan parasite infections in landlocked and anadromous Arctic charr (*Salvelinus alpinus* Linnaeus), and their use as indicators of movement to sea in young anadromous charr. *Canadian Journal of Zoology*, 67, 2478–2485.
<http://dx.doi.org/10.1139/z89-350>
- Bourgeois, C.E. & Ni, I.-H. (1984) Metazoan parasites of northwest Atlantic redfishes (*Sebastes* spp.). *Canadian Journal of Zoology*, 62, 1879–1885.
<http://dx.doi.org/10.1139/z84-274>
- Bousfield, E.L. & Kabata, Z. (1988) Amphipoda, pp. 149–163. In: Margolis, L. & Kabata, Z. (Eds.), Guide to the Parasites of Fishes of Canada. Part II—Crustacea. *Canadian Special Publication of Fisheries and Aquatic Sciences*, 107, 184 pp.
<http://dx.doi.org/10.1163/193724088x00567>
- Bowen, W.D. (Ed.) (1990) Population Biology of Sealworm (*Pseudoterranova decipiens*) in Relation to its Intermediate and Seal Hosts. *Canadian Bulletin of Fisheries and Aquatic Sciences* No. 222, 306 pp.
- Boyar, H.C. & Perkins, F.E. (1971) The occurrence of a larval nematode (*Anisakis* sp.) in adult herring from ICNAF subareas 4 and 5, 1962–1969. *International Commission for the Northwest Atlantic Fisheries Research Document*, Series No. 2576, No. 99, 2 pp.
- Boyce, N.P. (1966) The parasites of central British Columbia pink salmon during their early sea life, with special notes on the trematode *Lecithaster gibbosus*. *Fisheries Research Board of Canada Manuscript Reports (Biology)*, No. 877, 8 pp.
- Boyce, N.P. (1969) Parasite fauna of pink salmon (*Oncorhynchus gorbusha*) of the Bella Coola River, central British Columbia, during their early sea life. *Journal of the Fisheries Research Board of Canada*, 26, 813–820.
<http://dx.doi.org/10.1139/f69-079>
- Boyce, N.P. (1971) An instrument for removing cephalic sections of nematodes. *Transactions of the American Microscopical Society*, 90, 89–92.
<http://dx.doi.org/10.2307/3224903>
- Boyce, N.P. & Yamada, S.B. (1977) Effects of a parasite, *Eubothrium salvelini* (Cestoda: Pseudophyllidea), on the resistance of juvenile sockeye salmon, *Oncorhynchus nerka*, to zinc. *Journal of the Fisheries Research Board of Canada*, 34, 706–709.
<http://dx.doi.org/10.1139/f77-110>
- Boyes, J.W. & Anderson, R.C. (1961) Meiotic chromosomes of *Cystidicola stigmatura* and *C. cristivomeri* (Nematoda: Spiruroidea). *Canadian Journal of Genetics and Cytology*, 3, 231–236.
<http://dx.doi.org/10.1139/g61-026>
- Bradford, R.G. & Iles, T.D. (1992) Unique biological characteristics of spring-spawning herring (*Clupea harengus* L.) in Minas Basin, Nova Scotia, a tidally dynamic environment. *Canadian Journal of Zoology*, 70, 641–648.
<http://dx.doi.org/10.1139/z92-096>
- Bradley, C. (1961a) The effect of electrical stimulation at low temperatures on the larvae of *Phocanema decipiens*. *Canadian Journal of Zoology*, 39, 35–42.

<http://dx.doi.org/10.1139/z61-004>

- Bradley, C. (1961b) The effect of certain chemicals on the response to electrical stimulation and the spontaneous rhythmical activity of larvae of *Phocanema decipiens*. *Canadian Journal of Zoology*, 39, 129–136.
<http://dx.doi.org/10.1139/z61-016>
- Bradstreet, M.S.W., Finley, K.J., Sekerak, A.D., Griffiths, W.B., Evans, C.R., Fabijan, M.F. & Stallard, H.E. (1986) Aspects of the biology of Arctic cod (*Boreogadus saida*) and its importance in Arctic marine food chains. *Canadian Technical Report of Fisheries and Aquatic Sciences*, No. 1491, 193 pp.
- Bratney, J. (1988) A simple technique for recovering larval ascaridoid nematodes from the flesh of marine fish. *Journal of Parasitology*, 74, 735–737.
<http://dx.doi.org/10.2307/3282202>
- Bratney, J. (1995) Identification of larval *Contracaecum osculatum* s. l. and *Phocascaris* sp. (Nematoda: Ascaridoidea) from marine fishes by allozyme electrophoresis and discriminant function analysis of morphometric data. *Canadian Journal of Fisheries and Aquatic Sciences*, 52 (Suppl. 1), 116–128.
<http://dx.doi.org/10.1139/f95-517>
- Bratney, J. & Bishop, C.A. (1992) Larval *Anisakis simplex* (Nematoda: Ascaridoidea) infection in the musculature of Atlantic cod, *Gadus morhua*, from Newfoundland and Labrador. *Canadian Journal of Fisheries and Aquatic Sciences*, 49, 2635–2647.
<http://dx.doi.org/10.1139/f92-292>
- Bratney, J., Bishop, C.A. & Myers, R.A. (1990) Geographic distribution and abundance of *Pseudoterranova decipiens* (Nematoda: Ascaridoidea) in the musculature of Atlantic cod, *Gadus morhua*, from Newfoundland and Labrador. In: Bowen, W.D. (Ed.), Population Biology of Sealworm (*Pseudoterranova decipiens*) in Relation to its Intermediate and Seal Hosts. *Canadian Bulletin of Fisheries and Aquatic Sciences*, No. 222, 67–82.
- Bratney, J. & Davidson, W.S. (1996) Genetic variation within *Pseudoterranova decipiens* (Nematoda: Ascaridoidea) from Canadian Atlantic marine fishes and seals: characterization by RFLP and genomic DNA. *Canadian Journal of Fisheries and Aquatic Sciences*, 53, 333–341.
<http://dx.doi.org/10.1139/cjfas-53-2-333>
- Bray, R.A. (1987) A study of the helminth parasites of *Anarhichas lupus* (Perciformes: Anarhichadidae) in the North Atlantic. *Journal of Fish Biology*, 31, 237–264.
<http://dx.doi.org/10.1111/j.1095-8649.1987.tb05229.x>
- Brooks, D.R. & Hoberg, E.P. (2001) Parasite systematics in the 21st century: opportunities and obstacles. *Trends in Parasitology*, 17, 273–275.
[http://dx.doi.org/10.1016/s1471-4922\(01\)01894-3](http://dx.doi.org/10.1016/s1471-4922(01)01894-3)
- Burt, M.D.B., Appleton, T.E., Jarecka, L., Likely, C., MacKinnon, B.M. & Smith, J.W. (1990a) Detailed morphology of the sealworm, *Pseudoterranova decipiens* (Nematoda: Anisakinae) using light and scanning electron microscopy. *Abstract. Spring Meeting, British Society for Parasitology, 04–06 April 1990, University of Aberdeen, Aberdeen, Scotland.*
- Burt, M.D.B., Appleton, T., Jarecka, L., Likely, C.G., MacKinnon, B.M. & Smith, J.W. (1990b) Recent advances in our knowledge of the sealworm, *Pseudoterranova decipiens* (Nematoda: Anisakidae). *Abstracts. 7th International Congress of Parasitology, August 1990, Paris, France.*
- Burt, M.D.B., Campbell, J.D., Likely, C.G. & Smith, J.W. (1990c) Serial passage of larval *Pseudoterranova decipiens* (Nematoda: Ascaridoidea) in fish. *Canadian Journal of Fisheries and Aquatic Sciences*, 47, 693–695.
<http://dx.doi.org/10.1139/f90-077>
- Burt, M.D.B., Jarecka, L. & Appleton, T.E. (1990d) Differentiation of sealworm siblings using intermediate hosts and isoelectric focusing. *Abstract. Spring Meeting, British Society for Parasitology, 04–06 April 1990, University of Aberdeen, Aberdeen, Scotland.*
- Burt, M.D.B., Jarecka, L. & Likely, C.G. (1989a) Marine anisakines: recent advances in our knowledge. *Program and Abstracts. 29th Annual Meeting, Canadian Society of Zoologists, May 1990, York University, Toronto.*
- Burt, M.D.B., Likely, C.G. & MacKinnon, B.M. (1989b) Culturing *Pseudoterranova decipiens*, *Contracaecum osculatum* and *Anisakis simplex* (Nematoda) *in vivo* and *in vitro*. *Abstract. Spring Meeting, British Society for Parasitology, April 1990, Southampton, England.*
- Bush, A.O., Lafferty, K.D., Lotz, J.M. & Shostak, A.W. (1997) Parasitology meets ecology on its own terms. Margolis *et al.* revisited. *Journal of Parasitology*, 83, 575–583.
<http://dx.doi.org/10.2307/3284227>
- Bykhovskaya-Pavlovskaya, I.E., A.V. Gushev, M.N. Dubinina, N.A. Izyumova, T.S. Smirova, I.L. Sokolovskaya, G.A. Shtein, S.S. Shulman & V.H. Epshtein (1964) *Key to Parasites of Freshwater Fishes of the USSR*. Israel Program for Scientific Translations, Jerusalem (translation of the 1962 Russian original), 919 pp.
- Byrne, P.J. (1989) Transmission and epizootiology of two *Rhabdochona* spp. (Thelazioidea) in stream fishes in southern Ontario. M. Sc. Thesis, Department of Zoology, University of Guelph, Guelph, Ontario.
- Byrne, P.J. (1992a) *Rhabdochona rotundicaudatum* n. sp. and a redescription of *R. cascadiella* Wigdor, 1918 (Nematoda: Thelazioidea) from minnows in southern Ontario, Canada. *Canadian Journal of Zoology*, 70, 476–484.
<http://dx.doi.org/10.1139/z92-072>
- Byrne, P.J. (1992b) On the biology of *Rhabdochona rotundicaudatum* and *R. cascadiella* (Nematoda: Thelazioidea) in stream

- fishes from southern Ontario, Canada. *Canadian Journal of Zoology*, 70, 485–493.
<http://dx.doi.org/10.1139/z92-073>
- Byrne, P.J. & Baker, M.R. (1987) The biology of *Rhabdochona cascadiella* Wigdor, 1918 (Nematoda: Spirurida) in the common shiner from a southern Ontario stream. Program and Abstracts. 26th Annual Meeting, Canadian Society of Zoologists, McGill University, 13–15 May 1987. *Bulletin of the Canadian Society of Zoologists*, 18, p. 22.
- Cain, G.D. & Raj, R.K. (1980) *Anisakis*, *Phocanema*, *Contracaecum*, and *Sulcascaris* spp.: electrophoresis and thermostability of alcohol and malate dehydrogenases from larvae. *Experimental Parasitology*, 49, 56–67.
[http://dx.doi.org/10.1016/0014-4894\(80\)90056-9](http://dx.doi.org/10.1016/0014-4894(80)90056-9)
- Campbell, D.M., Bradford, R. G. & Jones, K.M.M. (2013) Occurrences of *Anguillicoloides crassus*, an invasive parasitic nematode, infecting American eel (*Anguilla rostrata*) collected from New Brunswick and Nova Scotia rivers: 2008–2009. *DFO Canadian Science Advisory Secretariat, Research Document*, 2012/082, iv + 19 pp.
- Cannon, L.R.G. (1973) Diet and intestinal helminths in a population of perch, *Perca flavescens*. *Journal of Fish Biology*, 5, 447–457.
<http://dx.doi.org/10.1111/j.1095-8649.1973.tb04474.x>
- Cannon, L.R.G. (1977) Some larval ascaridoids from southeastern Queensland marine fishes. *International Journal for Parasitology*, 7, 233–243.
[http://dx.doi.org/10.1016/0020-7519\(77\)90053-4](http://dx.doi.org/10.1016/0020-7519(77)90053-4)
- Carney, J.P. & Dick, T.A. (1999) Enteric helminths of perch (*Perca fluviatilis* L.) and yellow perch (*Perca flavescens* Mitchell): stochastic or predictable assemblages? *Journal of Parasitology*, 85, 785–795.
<http://dx.doi.org/10.2307/3285812>
- Carney, J.P. & Dick, T.A. (2000) Helminth communities of yellow perch (*Perca flavescens* (Mitchill)): determinants of pattern. *Canadian Journal of Zoology*, 78, 538–555.
<http://dx.doi.org/10.1139/z99-222>
- Carney, J.P., Sheldon, T.A. & Lovejoy, N.R. (2009) Parasites of the deepwater sculpin (*Myoxocephalus thompsonii*) across its Canadian range. *Journal of Parasitology*, 95, 1209–1212.
<http://dx.doi.org/10.1645/ge-2011.1>
- Caspeta-Mandujano, J.M., Moravec, F. & Salgado-Maldonado, G. (1999) Observations on cucullanid nematodes from freshwater fishes in Mexico, including *Dichelyne mexicanus* sp. n. *Folia Parasitologica*, 46, 289–295.
- Chabaud, A.G. (1974) Class Nematoda. Keys to Subclasses, Orders and Superfamilies. In: Anderson, R.C., Chabaud, A.G. & Willmott, S. (Eds.), *CIH Keys to the Nematode Parasites of Vertebrates*. No. 1, pp. 6–17. Commonwealth Agricultural Bureaux, Farnham Royal, Bucks, England.
- Chabaud, A.G. (1975a) Keys to the Genera of the Order Spirurida. Part 1. Camallanoidea, Dracunculoidea, Gnathostomatoidea, Physalopteroidea, Rictularioidea and Thelazioidea. In: Anderson, R.C., Chabaud, A.G. & Willmott, S. (Eds.), *CIH Keys to the Nematode Parasites of Vertebrates*. No. 3, pp. 1–26. Commonwealth Agricultural Bureaux, Farnham Royal, Bucks, England.
- Chabaud, A.G. (1975b) Keys to Genera of the Order Spirurida. Part 2. Spiruroidea, Habronematoidea and Acuarioidea. In: Anderson, R.C., Chabaud, A.G. & Willmott, S. (Eds.), *CIH Keys to the Nematode Parasites of Vertebrates*. No. 3, pp. 29–58. Commonwealth Agricultural Bureaux, Farnham Royal, Bucks, England.
- Chabaud, A.G. (1978) Keys to Genera of the Superfamilies Cosmocercidae, Seuratoidea, Heterakoidea and Subuluroidea. In: Anderson, R.C., Chabaud, A.G. & Willmott, S. (Eds.), *CIH Keys to the Nematode Parasites of Vertebrates*. No. 6, 71 pp. Commonwealth Agricultural Bureaux, Farnham Royal, Bucks, England.
- Chan, G.-L. (1980) Study of some parasites of the white sucker, *Catostomus commersoni* (Lacépède), and the fathead minnow, *Pimephales promelas* Rafinesque, in a reservoir and its contiguous streams. Ph. D. Dissertation. Department of Biology, University of Waterloo, Waterloo, Ontario, 298 pp.
- Chandra, C.V. & Khan, R.A. (1988) Nematode infestation of fillets from Atlantic cod, *Gadus morhua*, off eastern Canada. *Journal of Parasitology*, 74, 1038–1040.
<http://dx.doi.org/10.2307/3282229>
- Chenoweth, J.F., McGladdery, S.E., Sindermann, C.J., Sawyer, T.K. & Bier, J.W. (1986) An investigation into the usefulness of parasites as tags for herring (*Clupea harengus*) stocks in the western North Atlantic, with emphasis on use of the larval nematode *Anisakis simplex*. *Journal of Northwest Atlantic Fishery Science*, 7, 25–33.
<http://dx.doi.org/10.2960/j.v7.a3>
- Chinniah, V.C. & Threlfall, W. (1978) Metazoan parasites of fish from the Smallwood Reservoir, Labrador, Canada. *Journal of Fish Biology*, 13, 203–213.
<http://dx.doi.org/10.1111/j.1095-8649.1978.tb03427.x>
- Chitwood, M. (1970) Nematodes of medical significance found in market fish. *American Journal of Tropical Medicine and Hygiene*, 19, 599–602.
- Choquette, L.P.E. (1948a) Parasites of freshwater fish. IV. Internal helminths parasitic in speckled trout (*Salvelinus fontinalis* (Mitchill)) in rivers and lakes of the Laurentide Park, Quebec, Canada. *Canadian Journal of Research, Section D*, 26, 204–211.
<http://dx.doi.org/10.1139/cjr48d-017>
- Choquette, L.P.E. (1948b) On the species of the genus *Metabronema* Yorke and Maplestone, 1926, parasitic in trout and char.

- Choquette, L.P.E. (1951a) On the nematode genus *Rhabdochona* Railliet, 1916 (Nematoda: Spiruroidea). *Canadian Journal of Zoology*, 29, 1–16.
<http://dx.doi.org/10.1139/z51-001>
- Choquette, L.P.E. (1951b) Description of *Metabronema prevosti* sp. nov. with a note on the genus and a list of its species and their host and geographical distribution. *Canadian Journal of Zoology*, 29, 102–108.
<http://dx.doi.org/10.1139/z51-011>
- Choquette, L.P.E. (1951c) Parasites of freshwater fish. V. Parasitic helminths of the muskallunge [sic], *Esox masquinongy* Mitchill, in the St. Lawrence watershed. *Canadian Journal of Zoology*, 29, 290–295.
<http://dx.doi.org/10.1139/z51-026>
- Choquette, L.P.E. (1955) The life history of the nematode *Metabronema salvelini* (Fujita, 1920) parasitic in the speckled trout, *Salvelinus fontinalis* (Mitchill), in Quebec, Canada. *Canadian Journal of Zoology*, 33, 1–4.
<http://dx.doi.org/10.1139/z55-001>
- Choudhury, A., Bruch, R & Dick, T.A. (1996) Helminths and food habits of lake sturgeon *Acipenser fulvescens* from the Lake Winnebago system, Wisconsin. *American Midland Naturalist*, 135, 274–282.
<http://dx.doi.org/10.2307/2426710>
- Choudhury, A. & Dick, T.A. (1991) Parasites of lake sturgeon, *Acipenser fulvescens* (Chondrostei: Acipenseridae) from the prairie region of Canada. *Program and Abstracts. 30th Annual Meeting, Canadian Society of Zoologists, Lakehead University, 08–11 May 1991. Bulletin of the Canadian Society of Zoologists*, 22, p. 30.
- Choudhury, A. & Dick, T.A. (1992) *Spinitectus acipenseri* n. sp. (Nematoda: Cystidicolidae) from the lake sturgeon *Acipenser fulvescens* (Rafinesque) in Canada. *Systematic Parasitology*, 22, 131–140.
<http://dx.doi.org/10.1007/bf00009605>
- Choudhury, A. & Dick, T.A. (1993) Parasites of the lake sturgeon, *Acipenser fulvescens* (Chondrostei: Acipenseridae), from central Canada. *Journal of Fish Biology*, 42, 571–584.
<http://dx.doi.org/10.1006/jfbi.1993.1060>
- Choudhury, A. & Dick, T.A. (1996a) Observations on the morphology of *Truttaedacnitis clitellarius* and *T. lebedevi* (Nematoda: Cucullanidae) from acipenserids and synonymy of the two species. *Systematic Parasitology*, 33, 89–99.
<http://dx.doi.org/10.1007/bf00009425>
- Choudhury, A. & Dick, T.A. (1996b) Observations on the morphology, systematics, and biogeography of the genus *Truttaedacnitis* (Nematoda: Cucullanidae). *Journal of Parasitology*, 82, 977–987.
<http://dx.doi.org/10.2307/3284209>
- Choudhury, A. & Dick, T. A. (1997) Parasites of the broad whitefish from the Mackenzie Delta. In: Tallman, R.F. & Reist, J.D. (Eds.), *Proceedings of the Broad Whitefish Workshop: the biology, traditional knowledge and scientific management of broad whitefish (Coregonus nasus (Pallas)) in the lower Mackenzie River*: p. 167–177. *Canadian Technical Report of Fisheries and Aquatic Sciences*, No. 2193, xi + 219 pp.
- Choudhury, A. & Dick, T.A. (1998) Patterns and determinants of helminth communities in the Acipenseridae (Actinopterygii: Chondrostei), with special reference to the lake sturgeon, *Acipenser fulvescens*. *Canadian Journal of Zoology*, 76, 330–349.
<http://dx.doi.org/10.1139/z97-189>
- Choudhury, A. & Dick, T.A. (2001) Sturgeons (Chondrostei: Acipenseridae) and their metazoan parasites: patterns and processes in historical biogeography. *Journal of Biogeography*, 28, 1411–1439.
<http://dx.doi.org/10.1046/j.1365-2699.2001.2811121411.x>
- Choudhury, A., Dick, T.A., Holloway, H. & Ottinger, C. (1990) The lake sturgeon – *Acipenser fulvescens* (Chondrostei, Acipenseridae) in Canada: preliminary studies on parasitofauna and immunological parameters. In: Interbasin Biota Transfer, North Dakota Water Quality Symposium, 20–21 March 1990. North Dakota State University, Fargo, North Dakota.
- Choudhury, A. & Nadler, S.A. (2016) Phylogenetic relationships of Cucullanidae (Nematoda), with observations on Seuratoidea and the monophyly of *Cucullanus*, *Dichelyne* and *Truttaedacnitis*. *Journal of Parasitology*, 102, 87–93.
<http://dx.doi.org/10.1645/15-806>
- Choudhury, A. & Perryman, B.J. (2003) *Spinitectus macrospinosus* n. sp. (Nematoda: Cystidicolidae) from the channel catfish *Ictalurus punctatus* in southern Manitoba and its distribution in other *Ictalurus* spp. *Journal of Parasitology*, 89, 782–791.
<http://dx.doi.org/10.1645/ge-3011>
- Christian, F.A. (1972) *Spinitectus micracanthus* sp. n. (Nematoda: Rhabdochonidae) from the bluegill, *Lepomis macrochirus* Rafinesque, in Ohio. *Proceedings of the Helminthological Society of Washington*, 39, 51–54.
<http://dx.doi.org/10.2307/2424173>
- Clemens, W.A. (1920) Histories of new food fishes. IV. The muttonfish. *Bulletin of the Biological Board of Canada*, No. 4, 312.
<http://dx.doi.org/10.5962/bhl.title.63919>
- Clemens, W.A. & Clemens, L.S. (1921) Contribution to the biology of the muttonfish, *Zoarces anguillaris*. *Contributions to Canadian Biology*, 1918–1920, 69–83.

<http://dx.doi.org/10.1139/f17-024>

- Clemens, W.A. & Wilby, G.V. (1961) *Fishes of the Pacific Coast of Canada*, 2nd edition. Fisheries Research Board of Canada Bulletin, No. 68, 443 pp.
- Cobb, N.A. (1915) Nematodes and their relationships. *Year Book, Department of Agriculture 1914*, pp. 457–490. Washington, DC, Department of Agriculture.
- Collins, J.J. & Dechtiar, A.O. (1974) Parasite fauna of kokanee salmon (*Oncorhynchus nerka*) introduced into Lake Huron. *Journal of the Fisheries Research Board of Canada*, 31, 1818–1821.
<http://dx.doi.org/10.1139/f74-234>
- Conboy, G.A. & Speare, D.J. (2002) Dermal nematodosis in commercially captured rockfish (*Sebastes* spp.) from coastal British Columbia, Canada. *Journal of Comparative Pathology*, 127, 211–213.
<http://dx.doi.org/10.1053/jcpa.2002.0567>
- Cone, D.K. & Anderson, R.C. (1977) Parasites of pumpkinseed (*Lepomis gibbosus* L.) from Ryan Lake, Algonquin Park, Ontario. *Canadian Journal of Zoology*, 55, 1410–1423.
<http://dx.doi.org/10.1139/z77-184>
- Cone, D.K., Marcogliese, D.J. & Watt, W.D. (1993) Metazoan parasite communities of yellow eels (*Anguilla rostrata*) in acidic and limed rivers of Nova Scotia. *Canadian Journal of Zoology*, 71, 177–184.
<http://dx.doi.org/10.1139/z93-024>
- Cone, D.K. & Ryan, P.M. (1984) Population sizes of metazoan parasites of brook trout (*Salvelinus fontinalis*) and Atlantic salmon (*Salmo salar*) in a small Newfoundland lake. *Canadian Journal of Zoology*, 62, 130–133.
<http://dx.doi.org/10.1139/z84-020>
- Couillard, C.M., Hodson, P.V., Gagnon, P. & Dodson, J.J. (1995) Lesions and parasites in white suckers, *Catostomus commersoni*, in bleached-kraft pulp mill-contaminated and reference rivers. *Environmental Toxicology and Chemistry*, 14, 1051–1060.
<http://dx.doi.org/10.1002/etc.5620140616>
- Crampton, E.W., Donefer, E. & Schad, D.J. (1960) Effect of the ingestion of *Porrocaecum* (codworm) on growth, voluntary intake and feed efficiency of beagle pups. *Journal of the Fisheries Research Board of Canada*, 17, 501–505.
<http://dx.doi.org/10.1139/f60-035>
- Croll, N.A., Ma, K., Smith, J.M., Sukhdeo, M.V.K. & Wild, G. (1980) *Phocanema decipiens*: intestinal penetration in the laboratory rat. *Experimental Parasitology*, 50, 145–154.
[http://dx.doi.org/10.1016/0014-4894\(80\)90016-8](http://dx.doi.org/10.1016/0014-4894(80)90016-8)
- Crossman, E.J. (1962) The grass pickerel *Esox americanus vermicularis* LeSueur in Canada. *Royal Ontario Museum Life Science Contribution*, 55, 29 pp.
<http://dx.doi.org/10.5962/bhl.title.52172>
- Curtis, M.A. (1979) Metazoan parasites of resident Arctic char (*Salvelinus alpinus*) from a small lake on southern Baffin Island. *Le Naturaliste Canadien (Québec)*, 106, 337–338.
- Curtis, M.A. (1982) Host-parasite interactions in Arctic and sub-Arctic lakes. In: Meerovitch, E. (Ed.). *Aspects of Parasitology – a Festschrift dedicated to the 50th Anniversary of the Institute of Parasitology, McGill University, 1932–1982*. McGill University, Montreal, Quebec, Canada, pp. 41–57.
<http://dx.doi.org/10.1017/s0031182000054895>
- Curtis, M.A. (1984) The influence of food web structure on parasite transmission to Arctic char (*Salvelinus alpinus*) in northern Canada. *Proceedings. British Society for Parasitology, 04–06 April 1984, University of Bristol. Parasitology*, 89 (2), xlix.
- Curtis, M.A., Berube, M. & Stenzel, A. (1995) Parasitological evidence for specialized foraging behavior in lake-resident Arctic charr (*Salvelinus alpinus*). *Canadian Journal of Fisheries and Aquatic Sciences*, 52 (Suppl. 1), 186–194.
<http://dx.doi.org/10.1139/f95-526>
- Dailey, M.D. (1966) Biology and morphology of *Philometroides nodulosa* (Thomas, 1929) n. comb. (Philometridae: Nematoda) in the western white sucker (*Catostomus commersoni*). Unpublished Ph.D. Thesis, Colorado State University, Fort Collins, Colorado, x + 77 pp.
- Dailey, M.D. (1996) *Meyer, Olsen & Schmidt's Essentials of Parasitology*, 6th Edition. McGraw-Hill, Boston, Bangkok, Mexico City, xii + 289 pp.
- Davey, K.G. (1965) Molting in a parasitic nematode, *Phocanema decipiens*. I. Cytological events. *Canadian Journal Zoology*, 43, 997–10
<http://dx.doi.org/10.1139/z65-103>
- Davey, K.G. (1966) Neurosecretion and molting in some parasitic nematodes. *American Zoology*, 6, 243–249.
<http://dx.doi.org/10.1093/icb/6.2.243>
- Davey, K.G. (1969) Molting in a parasitic nematode, *Phocanema decipiens*. V. Timing of feeding during the moulting cycle. *Journal of the Fisheries Research Board of Canada*, 26, 935–939.
<http://dx.doi.org/10.1139/f69-090>
- Davey, K.G. (1971) Molting in a parasitic nematode, *Phocanema decipiens*. VI. The mode of action of insect juvenile hormone and farnesyl methyl ether. *International Journal for Parasitology*, 1, 61–66.
[http://dx.doi.org/10.1016/0020-7519\(71\)90047-6](http://dx.doi.org/10.1016/0020-7519(71)90047-6)

- Davey, K.G. (1979) Molting in a parasitic nematode, *Phocanema decipiens*: the role of water uptake. *International Journal for Parasitology*, 9, 121–125.
[http://dx.doi.org/10.1016/0020-7519\(79\)90101-2](http://dx.doi.org/10.1016/0020-7519(79)90101-2)
- Davey, K.G. (1986) A possible hormone controlling oxygen consumption in the nematode *Phocanema decipiens*. *General and Comparative Endocrinology*, 64, 30–35.
[http://dx.doi.org/10.1016/0016-6480\(86\)90024-9](http://dx.doi.org/10.1016/0016-6480(86)90024-9)
- Davey, K.G. & Goh, S.L. (1984) Ecdysis in a parasitic nematode: direct evidence for a ecdysial factor from the head. *Canadian Journal of Zoology*, 62, 2293–2296.
<http://dx.doi.org/10.1139/z84-334>
- Davey, K.G. & Sommerville, R.I. (1974) Molting in a parasitic nematode, *Phocanema decipiens* – VII. The mode of action of the ecdysial hormone. *International Journal for Parasitology*, 4, 241–259.
[http://dx.doi.org/10.1016/0020-7519\(74\)90080-0](http://dx.doi.org/10.1016/0020-7519(74)90080-0)
- De Ley, P. & Blaxter, M.L. (2002) Systematic position and phylogeny. In: Lee, D.L. (Ed.), *The Biology of Nematodes*. Taylor & Francis, London and New York, pp.1–30.
http://dx.doi.org/10.4324/9780203166437_chapter_1
- Deardorff, T.L. & Overstreet, R.M. (1981) Review of *Hysterothylacium* and *Iheringascaris* (both previously=*Thynnascaris*) (Nematoda: Anisakidae) from the northern Gulf of Mexico. *Proceedings of the Biological Society of Washington*, 93, 1035–1079.
- Dechtiar, A.O. (1972a) Parasites of fish from Lake of the Woods, Ontario. *Journal of the Fisheries Research Board of Canada*, 29, 275–283.
<http://dx.doi.org/10.1139/f72-046>
- Dechtiar, A.O. (1972b) New parasite records for Lake Erie fish. *Great Lakes Fishery Commission, Technical Report*, No. 17, 20 pp.
- Dechtiar, A.O. & Berst, A.H. (1978) Parasite fauna of splake (*Salvelinus fontinalis* x *S. namaycush*). *Proceedings of the Helminthological Society of Washington*, 45, 249–254.
- Dechtiar, A.O. & Christie, W.J. (1988) Survey of the parasite fauna of Lake Ontario fishes, 1961 to 1971. In: Nepszy, S.J. (Ed.), *Parasites of Fishes in the Canadian waters of the Great Lakes*. *Great Lakes Fishery Commission, Technical Report*, No. 51, 66–95.
- Dechtiar, A.O., Collins, J.J. & Reckahn, J.A. (1988) Survey of the parasite fauna of Lake Huron fishes, 1961 to 1971. In: Nepszy, S.J. (Ed.), *Parasites of Fishes in the Canadian waters of the Great Lakes*. *Great Lakes Fishery Commission, Technical Report*, No. 51, 19–48.
- Dechtiar, A.O. & Lawrie, A.H. (1988) Survey of the parasite fauna of Lake Superior fishes, 1969 to 1975. In: Nepszy, S.J. (Ed.), *Parasites of Fishes in the Canadian waters of the Great Lakes*. *Great Lakes Fishery Commission, Technical Report*, No. 51, 1–18.
- Dechtiar, A.O., MacLean, J.A. & Nepszy, S.J. (1989) *Parasites of Fishes from Algonquin Park lakes*. *Ontario Fisheries, Technical Report Series*, No. 29, 10 pp.
- Dechtiar, A.O. & Nepszy, S.J. (1988) Survey of the parasite fauna of selected fish species from Lake Erie, 1970 –1975. In: Nepszy, S.J. (Ed.), *Parasites of Fishes in the Canadian waters of the Great Lakes*. *Great Lakes Fishery Commission, Technical Report*, No. 51, 49–65.
- Denny, S.K., Denny, A. & Paul, T. (2013) Distribution, prevalence and intensity of *Anguillicoloides crassus* in the American eel, *Anguilla rostrata*, in the Bras d’Or Lakes, Nova Scotia. *BioInvasions Records*, 2, 19–26.
<http://dx.doi.org/10.3391/bir.2013.2.1.03>
- des Clers, S. (1989) Modeling regional differences in *Pseudoterranova decipiens* infections in some North Atlantic cod stocks. In: Möller, H. (Ed.), *Nematode problems in North Atlantic fish*. Report from a workshop in Kiel, 03–04 April 1989. International Council for the Exploration of the Sea. Mariculture Committee, C. M. 1989/F6, pp. 32–36.
- des Clers, S. (1991) Functional relationships between sealworm (*Pseudoterranova decipiens*) burden and host size of Atlantic cod (*Gadus morhua*). *Proceedings of the Royal Society of London, Series B*, 245 (1313), 85–89.
<http://dx.doi.org/10.1098/rspb.1991.0092>
- Desdevises, Y., Arthur, J.R. & Pellerin-Massicotte, J. (1998) Parasites of anadromous Arctic char (*Salvelinus alpinus* L.) from two sites in Ungava Bay (Quebec, Canada). *Journal of the Helminthological Society of Washington*, 65, 87–90.
- Desportes, G. & McClelland, G. (Eds.) (2001) *Sealworms in the North Atlantic: Ecology and Population Dynamics*. The North Atlantic Marine Mammal Commission Scientific Publications, Volume 3, 177 pp.
<http://dx.doi.org/10.7557/3.2955>
- Despres, L., Adamson, M.L. & McDonald, T.E. (1995) Development of a diagnostic molecular marker for *Philonema* spp. (Nematoda: Dracunculoidea) infecting salmonids in British Columbia. *Canadian Journal of Fisheries and Aquatic Sciences*, 52 (Suppl. 1), 129–133.
<http://dx.doi.org/10.1139/f95-518>
- Dextrase, A.J. & Lankester, M.W. (1987) The biology of *Cystidicola farionis* (Habronematoidea) in salmonid fishes. Program and Abstracts. 26th Annual Meeting, Canadian Society of Zoologists, McGill University, 13–15 May 1987. *Bulletin of the Canadian Society of Zoologists*, 18, p. 22.
- Dick, T.A. (1984) Parasites and Arctic charr management – an academic curiosity or practical reality? In: Johnson, L. & Burns,

- B.L. (Eds.), *Biology of Arctic charr*. Proceedings of the International Symposium on Arctic charr, May 1981, Winnipeg, Manitoba: pp. 371–394. University of Manitoba Press, Winnipeg, Manitoba. 584 pp.
- Dick, T.A. (1987) The atrium of the fish heart as a site for *Contracaecum* sp. larvae. *Journal of Wildlife Diseases*, 23, 328–330. <http://dx.doi.org/10.7589/0090-3558-23.2.328>
- Dick, T.A. & Belosevic, M. (1981) Parasites of Arctic charr *Salvelinus alpinus* (Linnaeus) and their use in separating sea-run and non-migrating charr. *Journal of Fish Biology*, 18, 339–347. <http://dx.doi.org/10.1111/j.1095-8649.1981.tb03775.x>
- Dick, T.A., Papst, M.H. & Paul, H.C. (1987) Rainbow trout (*Salmo gairdneri*) stocking and *Contracaecum* spp. *Journal of Wildlife Diseases*, 23, 242–247. <http://dx.doi.org/10.7589/0090-3558-23.2.242>
- Dickson, T.W. (1964) Parasites of some fishes in Manitoba. M. Sc. Thesis, Department of Zoology, University of Manitoba, Winnipeg, Manitoba, 161 pp.
- Dixon, B., Kimmins, W. & Pohajdak, B. (1993) Variation in colour of *Pseudoterranova decipiens* (Nematoda; Anisakidae) larvae correlates with haemoglobin concentration in the pseudocoelomic fluid. *Canadian Journal of Fisheries and Aquatic Sciences*, 50, 767–771. <http://dx.doi.org/10.1139/f93-088>
- Dombroski, E. (1955) Cestode and nematode infection of sockeye smolts from Babine Lake, British Columbia. *Journal of the Fisheries Research Board of Canada*, 12, 93–96. <http://dx.doi.org/10.1139/f55-007>
- Dornheim, H. (1973) Nematodenlarven im Hering der nordamerikanischen Ostküste in den Jahren 1969 bis 1972. *Informationen für Fischwirtschaft*, 20, 3–5.
- Drouin, T.E. (1982) Parasites and parasitism of the whitefish of Lake McGregor and Travers Reservoir, Alberta. Ph. D. Dissertation. Department of Biology, University of Calgary, Calgary, Alberta.
- Dubois, N., Marcogliese, D.J. & Magnan, P. (1996) Effects of the introduction of white sucker, *Catostomus commersoni*, on the parasite fauna of brook trout, *Salvelinus fontinalis*. *Canadian Journal of Zoology*, 74, 1304–1312. <http://dx.doi.org/10.1139/z96-146>
- Dunbar, M.J. & Hildebrand, H.H. (1952) Contribution to the study of fishes of Ungava Bay. *Journal of the Fisheries Research Board of Canada*, 9, 83–128. <http://dx.doi.org/10.1139/f52-005>
- Dunn, C.W., Hejnol, A., Matus, D.Q., Pang, K., Browne, W.E., Smith, S.A., Seaver, E., Rouse, G.W., Obst, M., Edgecombe, G.D., Sørensen, M.V., Haddock, S.H.D., Schmidt-Rhaesa, A., Okusu, A., Kristensen, R.M., Wheeler, W.C., Marindale, M.Q. & Giribet, G. (2008) Broad phylogenomic sampling improves resolution of the animal tree of life. *Nature*, 452 (7188), 745–749. <http://dx.doi.org/10.1038/nature06614>
- Dunn, I.J., Russell, L.R. & Adams, J.R. (1983) Cecal histopathology caused by *Truttaedacnitis truttae* (Nematoda: Cucullanidae) in rainbow trout, *Salmo gairdneri*. *International Journal for Parasitology*, 13, 441–445. [http://dx.doi.org/10.1016/s0020-7519\(83\)80006-x](http://dx.doi.org/10.1016/s0020-7519(83)80006-x)
- Durette-Desset, M.-C. (1983) Keys to Genera of the Superfamily Trichostrongyloidea. In: Anderson, R.C., Chabaud, A.G. & Willmott, S. (Eds.), *CIH Keys to the Nematode Parasites of Vertebrates*. No. 10, 85 pp. Commonwealth Agricultural Bureaux, Farnham Royal, Bucks, England.
- Eddy, S.B. & Lankester, M.W. (1978) Feeding and migratory habits of Arctic char, *Salvelinus alpinus*, indicated by the presence of the swimbladder nematode *Cystidicola cristivomeri* White. *Journal of the Fisheries Research Board of Canada*, 35, 1488–1491. <http://dx.doi.org/10.1139/f78-234>
- Ekbaum, E. (1935) Über eine neue *Cystidicola* in der Schwimmblase von *Oncorhynchus kisutch* Walbaum. *Zeitschrift für Parasitenkunde*, 7, 515. <http://dx.doi.org/10.1007/bf02122046>
- Ekbaum, E. (1936) Notes on the genus *Cystidicola* in Canadian fishes. *Canadian Field-Naturalist*, 50, 8–11.
- Fairbairn, D. (1958) Glucose, trehalose and glycogen in *Porrocaecum decipiens* larvae. *Nature (London)*, 181, 1593–1594. <http://dx.doi.org/10.1038/1811593a0>
- Faisal, M., Fayed, W., Brenden, T.O., Noor, A., Ebener, M.P., Wright, G.M. & Jones, M.L. (2010) Widespread infection of lake whitefish *Coregonus clupeaformis* with the swimbladder nematode *Cystidicola farionis* in northern lakes Michigan and Huron. *Journal of Great Lakes Research*, 36, 18–28. <http://dx.doi.org/10.1016/j.jglr.2010.01.008>
- Fantham, H.B. & Porter, A. (1948) The parasitic fauna of vertebrates in certain Canadian fresh waters, with some remarks on their ecology, structure and importance. *Proceedings of the Zoological Society of London, Series B*, 117, 609–649. <http://dx.doi.org/10.1111/j.1096-3642.1948.tb00543.x>
- Ferri, E., Barbuto, M., Bain, O., Galimberti, A., Uni, S., Guerrero, R., Ferté, H., Bandi, C., Martin, C. & Casiraghi, M. (2009) Integrated taxonomy: traditional approach and DNA barcoding for the identification of filarioid worms and related parasites (Nematoda). *Frontiers in Zoology*, 6, 1. <http://dx.doi.org/10.1186/1742-9994-6-1>

- Fillion, D.B. (1961) Parasites of the burbot (*Lota lota*) in Alberta. Department of Zoology, University of Alberta, Edmonton, Alberta. Unpublished report, 12 pp.
- Fleming, A.M. (1960) Age, growth and sexual maturity of cod (*Gadus morhua* L.) in the Newfoundland area, 1947–1950. *Journal of the Fisheries Research Board of Canada*, 17, 775–809.
<http://dx.doi.org/10.1139/f60-065>
- Forest, J.J.H. & Cone, D.K. (2011) Helminth parasites of golden shiner *Notemigonus crysoleucas* (Pisces: Cyprinidae) from Ontario and Nova Scotia, Canada. *Comparative Parasitology*, 78, 220–222.
<http://dx.doi.org/10.1654/4442.1>
- Frantsi, C., Flewelling, T.C. & Tidswell, K.G. (1975) Investigations on corynebacterial kidney disease and *Diplostomum* sp. (eye-fluke) at Margaree Hatchery, 1972–1973, Fisheries and Marine Service, Research and Development Branch, Environment Canada, Maritime Region, Technical Report Serial No. MAR/T-75-9, 30 pp.
- Fraser, C.M. (1921) Association, commensalism and parasitism among marine animals in the Strait of Georgia. *Canadian Field-Naturalist*, 35, 48–50.
- Fréchet, A., Dodson, J.J. & Powles, H. (1983) Les parasites de l'éperlan d'Amérique (*Osmerus mordax*) anadrome du Québec et leur utilité comme étiquettes biologiques. *Canadian Journal of Zoology*, 61, 621–626.
<http://dx.doi.org/10.1139/z83-083>
- Freeman, H.C., Hoogland, P.L. & Odense, P.H. (1963) The nature of an unusual amino acid-pyrimidine complex from the cod parasite, *Porrocaecum decipiens*. *Journal of the Fisheries Research Board of Canada*, 20, 1–11.
<http://dx.doi.org/10.1139/f63-002>
- Frimeth, J.P. (1986) Parasites as indicators of brook charr biology in the Tabusintac River, New Brunswick. Ph. D. Dissertation, University of New Brunswick, Fredericton, N.B., Canada.
<http://dx.doi.org/10.1139/z87-303>
- Frimeth, J.P. (1987a) A survey of the parasites of nonanadromous brook charr (*Salvelinus fontinalis*) in the Tabusintac River, New Brunswick, Canada. *Canadian Journal of Zoology*, 65, 1354–1362.
<http://dx.doi.org/10.1139/z87-215>
- Frimeth, J.P. (1987b) Potential use of certain parasites of brook charr (*Salvelinus fontinalis*) as biological indicators in the Tabusintac River, New Brunswick, Canada. *Canadian Journal of Zoology*, 65, 1989–1995.
<http://dx.doi.org/10.1139/z87-303>
- Fusé, M., Davey, K.G. & Sommerville, R.I. (1993a) Osmoregulation in the parasitic nematode *Pseudoterranova decipiens*. *Journal of Experimental Biology*, 175, 127–142.
- Fusé, M., Davey, K.G. & Sommerville, R.I. (1993b) Water compartments and osmoregulation in the parasitic nematode *Pseudoterranova decipiens*. *Journal of Experimental Biology*, 175, 143–152.
- Gaevskaya, A.V. & Umnova, B.A. (1977) [On the parasite fauna of the principal commercial fishes of the northwest Atlantic.] *Biologiya Morya (Vladivostok)*, 4, 40–48. [In Russian]
- Gardiner, M.A. (1990) Survival of *Anisakis* in cold smoked salmon. *Canadian Institute of Food Science and Technology Journal*, 23, 143–144.
[http://dx.doi.org/10.1016/s0315-5463\(90\)70219-2](http://dx.doi.org/10.1016/s0315-5463(90)70219-2)
- Garnick, E. & Margolis, L. (1990) Influence of four species of helminth parasites on orientation of seaward migrating sockeye salmon (*Oncorhynchus nerka*) smolts. *Canadian Journal of Fisheries and Aquatic Sciences*, 47, 2380–2389.
<http://dx.doi.org/10.1139/f90-265>
- Gibbons, L.M. (2002) General organisation. In: Lee, D.L. (Ed.), *The Biology of Nematodes*. Taylor & Francis, London and New York, pp. 31–59.
http://dx.doi.org/10.4324/9780203166437_chapter_2
- Gibbons, L.M. (2010) *Keys to the Nematode Parasites of Vertebrates. Supplementary Volume*. CAB International, Wallingford, UK, viii + 416 pp.
- Gibson, D.I. (1973) The genus *Pseudanisakis* Layman & Borovkova, 1926 (Nematoda: Ascaridoidea). *Journal of Natural History*, 7, 319–340.
<http://dx.doi.org/10.1080/00222937300770215>
- Gibson, D.I. (1996) Trematoda. In: Margolis, L. & Kabata, Z. (Eds.), *Guide to the Parasites of Fishes of Canada. Part IV. Canadian Special Publication of Fisheries and Aquatic Sciences*, 124, 373 pp.
<http://dx.doi.org/10.2307/3282617>
- Glenn, C.L. (1980) Seasonal parasitic infections in mooneye, *Hiodon tergisus* (LeSueur), from the Assiniboine River. *Canadian Journal of Zoology*, 58, 252–257.
<http://dx.doi.org/10.1139/z80-030>
- Godfrey, H. (1968) Some observations on juvenile marine chum, chinook and coho salmon taken in waters adjacent to Georgia Strait in 1965. *Fisheries Research Board of Canada Manuscript Report Series*, No. 955, 19 pp.
- Gopar-Merino, L., Osorio-Sarabia, D. & García-Prieto, L. (2005) A new species of *Hysterothylacium* (Nematoda: Anisakidae) parasite of *Ariopsis guatemalensis* (Osteichthyes: Ariidae) from Tres Palos Lagoon, Mexico. *Journal of Parasitology*, 91, 909–914.
<http://dx.doi.org/10.1645/ge-411r.1>
- Goh, S.L. & Davey, K.G. (1985) Occurrence of noradrenaline in the central nervous system of *Phocanema decipiens* and its

- possible role in the control of ecdysis. *Canadian Journal of Zoology*, 63, 475–479.
<http://dx.doi.org/10.1139/z85-067>
- Goil, M.M. & Harpur, R.P. (1978) Studies on sorbitol dehydrogenase from the parasitic nematode larvae of *Phocanema decipiens*. *Zeitschrift für Parasitenkunde*, 57, 117–120.
<http://dx.doi.org/10.1007/bf00927152>
- Goil, M.M. & Harpur, R.P. (1979) A comparison of the non-specific acid phosphomonoesterase activity in the larva of *Phocanema decipiens* (Nematoda) with that of the muscle of its host, the codfish (*Gadus morhua*). *Zeitschrift für Parasitenkunde*, 60, 177–183
<http://dx.doi.org/10.1007/bf00927973>
- Gordon, D., Croll, N.A. & Rau, M.E. (1978) Les parasites des animaux sauvages du Québec. I. Les parasites des poissons et des mammifères de la région de Schefferville. *Le Naturaliste Canadien (Québec)*, 105, 55–59.
- Greenberg, P. (2010) *Four Fish. The Future of the Last Wild Food*. The Penguin Press, New York, xiv + 285 pp.
<http://dx.doi.org/10.5950/0738-1360-27.3.283>
- Greenwood, P.H., Rosen, D.E., Weitzman, S.H. & Myers, G.S. (1966) Phyletic studies of teleostean fishes, with a provisional classification of living forms. *Bulletin of the American Museum of Natural History*, 131, 339–455.
<http://dx.doi.org/10.1643/ot-11-079>
- Greenwood, S.J. & Baker, M.R. (1987) *Cystidicoloides ephemeridarum* (Linstow, 1872) (Nematoda) in speckled trout, *Salvelinus fontinalis*, from southern Ontario. *Canadian Journal of Zoology*, 65, 2589–2593.
<http://dx.doi.org/10.1139/z87-392>
- Groot, C., Bailey, R., Margolis, L. & Cooke, K. (1989) Migratory patterns of sockeye salmon (*Oncorhynchus nerka*) smolts in the Strait of Georgia, British Columbia, as determined by analysis of parasite assemblages. *Canadian Journal of Zoology*, 67, 1670–1678.
<http://dx.doi.org/10.1139/z89-240>
- Groot, C., Margolis, L. & Bailey, R. (1984) Does the route of seaward migration of Fraser River sockeye salmon (*Oncorhynchus nerka*) smolts determine the route of return migration of the adults? In: J.D. McCleave, G.P. Arnold, J.J. Dodson & W.B. Neill (Eds.), *Mechanisms of Migration in Fishes*. NATO Conference Series, Series IV. Marine Sciences, Volume 14. Plenum Press, New York & London.
http://dx.doi.org/10.1007/978-1-4613-2763-9_17
- Gubanov, N.M. (1951) [Giant nematode from the placenta of Cetacea: *Placentonema gigantissima*.] *Proceedings of the USSR Academy of Sciences*, 77, 1123–1125. (In Russian.)
- Hanek, G. & Molnar, K. (1974) Parasites of freshwater and anadromous fishes from Matamek River System, Quebec. *Journal of the Fisheries Research Board of Canada*, 31, 1135–1139.
<http://dx.doi.org/10.1139/f74-129>
- Hanek, G. & Threlfall, W. (1970a) Parasites of the threespine stickleback (*Gasterosteus aculeatus*) in Newfoundland and Labrador. *Journal of the Fisheries Research Board of Canada*, 27, 901–907.
<http://dx.doi.org/10.1139/f70-096>
- Hanek, G. & Threlfall, W. (1970b) Metazoan parasites of the American eel (*Anguilla rostrata* (LeSueur)) in Newfoundland and Labrador. *Canadian Journal of Zoology*, 48, 597–600.
<http://dx.doi.org/10.1139/z70-105>
- Hanek, G. & Threlfall, W. (1970c) Helminth parasites of the four-spine stickleback (*Apeltes quadracus*) (Mitchill) in Newfoundland. *Canadian Journal of Zoology*, 48, 404–406.
<http://dx.doi.org/10.1139/z70-069>
- Hare, G.M. (1975) Atlantic salmon (*Salmo salar*) parasites as biological tags in the Miramichi River system. *Dissertation Abstracts International*, 35B, p. 4769.
<http://dx.doi.org/10.1139/f76-142>
- Hare, G.M. & Burt, M.D.B. (1975a) Identification, host sites and biology of parasites infecting juvenile Atlantic salmon (*Salmo salar*) in the Miramichi River system. Fisheries and Marine Service, Research and Development Directorate, Technical Report, No. 581, 34 pp.
- Hare, G.M. & Burt, M.D.B. (1975b) Abundance and population dynamics of parasites infecting Atlantic salmon (*Salmo salar*) in Trout Brook, New Brunswick, Canada. *Journal of the Fisheries Research Board of Canada*, 32, 2069–2074.
<http://dx.doi.org/10.1139/f75-245>
- Hare, G.M. & Burt, M.D.B. (1976) Parasites as potential biological tags of Atlantic salmon (*Salmo salar*) smolts in the Miramichi River System, New Brunswick. *Journal of the Fisheries Research Board of Canada*, 33, 1139–1141.
<http://dx.doi.org/10.1139/f76-142>
- Hare, G.M. & Frantsi, C. (1974) Abundance and potential pathology of parasites infecting salmonids in Canadian maritime hatcheries. *Journal of the Fisheries Research Board of Canada*, 31, 1031–1036.
<http://dx.doi.org/10.1139/f74-116>
- Hart, J.L. (1931) The food of the whitefish *Coregonus clupeaformis* (Mitchill) in Ontario waters, with a note on the parasites. *Contributions to Canadian Biology and Fisheries, New Series*, 6, 445–454.
<http://dx.doi.org/10.1139/f31-021>
- Hartwich, G. (1974) Keys to Genera of the Ascaridoidea. In: Anderson, R. C., Chabaud, A. G. & Willmott, S. (Eds.), *CIH Keys*

- to the Nematode Parasites of Vertebrates. No. 2, 14 pp. Commonwealth Agricultural Bureaux, Farnham Royal, Bucks, England.
- Hartwich, G. (1975) *Nemathelminthes, Nematoda I. Rhabditida and Ascaridida*. VEB Gustav Fischer Verlag, Jena, Germany, 256 pp.
- Hays, R., Measures, L.N. & Huot, J. (1998) Capelin (*Mallotus villosus*) and herring (*Clupea harengus*) as paratenic hosts of *Anisakis simplex*, a parasite of beluga (*Delphinapterus leucas*) in the St. Lawrence estuary. *Canadian Journal of Zoology*, 76, 1411–1417.
<http://dx.doi.org/10.1139/cjz-76-8-1411>
- Hebert, P.D.N., Cywinska, A., Ball, S.L. & deWaard, J.R. (2003) Biological identification through DNA barcodes. *Proceedings of the Royal Society of London*, 270, 313–321.
<http://dx.doi.org/10.1098/rspb.2002.2218>
- Heller, A.F. (1949) Parasites of cod and other marine fish from the Baie de Chaleur region. *Canadian Journal of Research*, 27D, 243–264.
<http://dx.doi.org/10.1139/cjr49d-022>
- Hicks, F.J. & Threlfall, W. (1973) Metazoan parasites of salmonids and coregonids from coastal Labrador. *Journal of Fish Biology*, 5, 399–415.
<http://dx.doi.org/10.1111/j.1095-8649.1973.tb04468.x>
- Hoar, W.S. & Hickman, C.P. (Eds.) (1975) *A Laboratory Companion for General and Comparative Physiology*. 2nd Edition. Prentice-Hall, Englewood Cliffs, New Jersey, USA.
- Hochberg, N.S. & Hamer, D.H. (2010) Anisakidosis: perils of the deep. *Clinical Infectious Diseases*, 51, 806–812.
<http://dx.doi.org/10.1086/656238>
- Hodder, V.M. & Parsons, L.S. (1970) A comparative study of herring taken at Magdalen Islands and along southwestern Newfoundland during the 1969 autumn fishery. *International Commission for the Northwest Atlantic Fisheries, Research Document No. 70/77, Serial No. 2425*, 11 pp.
- Hodder, V.M. & Parsons, L.S. (1971a) Comparison of certain biological characteristics of herring from Magdalen Islands and southwestern Newfoundland. *International Commission for the Northwest Atlantic Fisheries, Research Bulletin*, 8, 59–65.
- Hodder, V.M. & Parsons, L.S. (1971b) Some biological features of southwest Newfoundland and northern Scotian Shelf herring stocks. *International Commission for the Northwest Atlantic Fisheries, Research Bulletin*, 8, 67–73.
- Hodder, V.M. & Parsons, L.S. (1971c) Preliminary comparison of Scotian Shelf and southwest Newfoundland herring taken during the winter of 1971. *International Commission for the Northwest Atlantic Fisheries, Research. Document 71/120, Serial No. 2618*, 8 pp.
- Hodgkin, J., Horvitz, J.R., Jasny, B.R. & Kimble, J. (1998) *C. elegans*: sequence to biology. *Science* 282 (5396), 2011.
<http://dx.doi.org/10.1126/science.282.5396.2011>
- Hoffman, G.L. (1999) *Parasites of North American Freshwater Fishes*. 2nd Edition. Cornell University Press, 576 pp.
- Hogans, W.E. (1984) Helminths of striped bass (*Morone saxatilis*) from the Kouchibouguac River, New Brunswick. *Journal of Wildlife Diseases*, 20, 61–63.
<http://dx.doi.org/10.7589/0090-3558-20.1.61>
- Hogans, W.E., Bratney, J., Uhazy, L.S. & Hurley, P.C. (1983) Helminth parasites of swordfish (*Xiphias gladius* L.) from the northwest Atlantic Ocean. *Journal of Parasitology*, 69, 1178–1179.
<http://dx.doi.org/10.2307/3280895>
- Hogans, W.E., Dadsell, M.J., Uhazy, L.S. & Appy, R.G. (1993) Parasites of American shad, *Alosa sapidissima* (Osteichthyes: Clupeidae) from rivers of the North American Atlantic coast and the Bay of Fundy, Canada. *Canadian Journal of Zoology*, 71, 941–946.
<http://dx.doi.org/10.1139/z93-123>
- Hogans, W.E. & Hurlbut, T.R. (1984) Parasites of the knifefish chimaera, *Rhinochimaera atlantica*, from the northwest Atlantic Ocean. *Canadian Field-Naturalist*, 98, 365.
- Holmes, J.C. (1990) Helminth communities in marine fishes. In: Esch, G., Bush, A.O. & Aho, J. (Eds.), *Parasite Communities: Patterns and Processes*. Chapman & Hall, New York, pp. 101–130.
http://dx.doi.org/10.1007/978-94-009-0837-6_5
- Homans, R.E.S. & MacFarlane, A.S. (1957) Preliminary report on the occurrence of codworms in flounders of the Maritimes and on the efficiency of present candling methods in fish plants. *Canada Department of Fisheries, Inspection Branch, Maritimes Area, Halifax*. Pamphlet H, 7 pp.
- Homans, R.E.S. & MacFarlane, A.S. (1958) Progress report on the cod parasite survey in the Maritimes area. *Canada Department of Fisheries, Inspection Branch, Maritimes Area, Halifax*, 4 pp.
- Hoskins, G.E., Bell, G.R. & Evelyn, T.P.T. (1976) The occurrence, distribution and significance of infectious diseases and of neoplasms observed in fish in the Pacific Region up to the end of 1974. *Canadian Department of the Environment. Fisheries and Marine Service. Research and Development Directorate. Technical Report*, No. 609, 35 pp.
- Hoskins, G.E. & Hulstein, L.P. (1977) Annual report of the diagnostic service of the Fisheries and Marine Service, Pacific Region, for 1975. *Canadian Department of the Environment. Fisheries and Marine Service. Research and Development Directorate. Technical Report*, No. 707, 37 pp.
- Houde, M., Measures, L.N. & Huot, J. (2003) Experimental transmission of *Pharurus pallasii* (Nematoda:

- Metastrongyloidea), a lungworm of the cranial sinuses of the beluga whale (*Delphinapterus leucas*), to fish. *Canadian Journal of Zoology*, 81, 364–370.
<http://dx.doi.org/10.1139/z03-016>
- Houston, K.A. & Haedrich, R.L. (1986) Food habits and intestinal parasites of deep demersal fishes from the upper continental slope east of Newfoundland, northwest Atlantic. *Oceanography and Marine Biology*, 24, 563–574.
<http://dx.doi.org/10.1007/bf00392516>
- Huizinga, H.W. (1966) Studies on the life cycle and development of *Contracaecum spiculigerum* (Rudolphi, 1809) (Ascaroidea [sic]: Heterocheilidae) from marine piscivorous birds. *Journal of the Elisha Mitchell Scientific Society*, 82, 181–195.
- Hunter, G.W. III, & Bangham, R.V. (1933) Studies on the fish parasites of Lake Erie. II. New Cestoda and Nematoda. *Journal of Parasitology*, 19, 301–311.
<http://dx.doi.org/10.2307/3271589>
- Huntsman, A.G. (1918) The Canadian plaice. *Fisheries Research Board of Canada Bulletin*, No. 1, 32 pp.
<http://dx.doi.org/10.5962/bhl.title.63888>
- Hurst, R.J. (1984) Identification and description of larval *Anisakis simplex* and *Pseudoterranova decipiens* (Anisakidae: Nematoda) from New Zealand waters. *New Zealand Journal of Marine and Freshwater Research*, 18, 177–186.
<http://dx.doi.org/10.1080/00288330.1984.9516040>
- Iles, C. (1971) *Fisticula plicatus* (Cestoda) and *Tristoma* spp. (Trematoda) on [sic] swordfish from the northwest Atlantic. *Journal of the Fisheries Research Board of Canada*, 28, 31–34.
<http://dx.doi.org/10.1139/f71-005>
- Jamieson, J. & Freeman, R.S. (1975) Parasitology: Parasites of man and Arctic char at Igloolik. In: T.W.M. Cameron & L. W. Billingsley (Eds.), *Energy Flow: its Biological Dimension*. Summary of the International Biological Programme in Canada 1964–1974. Published by the Royal Society of Canada, Ottawa, pp. 290–293.
- Jilek, R. & Crites, J.L. (1982a) The life cycle and development of *Spinitectus carolini* Holl, 1928 (Nematoda: Spirurida). *American Midland Naturalist*, 107, 100–106.
<http://dx.doi.org/10.2307/2425192>
- Jilek, R. & Crites, J.L. (1982b) The life cycle and development of *Spinitectus gracilis* (Nematoda: Spirurida). *Transactions of the American Microscopical Society*, 101, 75–83.
<http://dx.doi.org/10.2307/3225572>
- Jilek, R. & Crites, J.L. (1982c) Comparative morphology of the North American species of *Spinitectus* (Nematoda: Spirurida) analyzed by scanning electron microscopy. *Transactions of the American Microscopical Society*, 101, 126–134.
<http://dx.doi.org/10.2307/3225764>
- Johansen, F. (1925) Natural history of the cunner (*Tautoglabrus adspersus* Walbaum). *Contributions to Canadian Biology, New Series*, 2, 423–467.
<http://dx.doi.org/10.1139/z01-155>
- Johnson, M.W. & Dick, T.A. (2001) Parasite effects on the survival, growth, and reproductive potential of yellow perch (*Perca flavescens* Mitchell) in Canadian Shield lakes. *Canadian Journal of Zoology*, 79, 1980–1992.
<http://dx.doi.org/10.1139/z01-155>
- Kabata, Z. (1988) Copepoda and Branchiura, pp. 3–127. In: L. Margolis & Z. Kabata (Eds.) *Guide to the Parasites of Fishes of Canada. Part II – Crustacea*. *Canadian Special Publication of Fisheries and Aquatic Sciences*, 101, 184 pp.
<http://dx.doi.org/10.1163/193724088x00567>
- Kabata, Z. & Whitaker, D.J. (1984) Results of three investigations of the parasite fauna of several marine fishes of British Columbia. *Canadian Technical Report of Fisheries and Aquatic Sciences*, No. 1303, 19 pp.
- Kakonge, S.A.K. (1972) The ecology of some metazoan parasites of, and their effects on, small stream fishes and fry. Ph. D. Dissertation. Department of Biology, University of Waterloo, Waterloo, Ontario.
- Kan, S.P. & Davey, K.G. (1968a) Molting in the parasitic nematode, *Phocanema decipiens*. II. Histochemical study of the larval and adult cuticle. *Canadian Journal of Zoology*, 46, 235–241.
<http://dx.doi.org/10.1139/z68-036>
- Kan, S.P. & Davey, K.G. (1968b) Molting in a parasitic nematode, *Phocanema decipiens*. III. The histochemistry of cuticle deposition and protein synthesis. *Canadian Journal of Zoology*, 46, 723–727.
<http://dx.doi.org/10.1139/z68-100>
- Kates, S., Wright, K.A. & Wright, H. (1973) A case of human infection with the cod nematode *Phocanema* sp. *American Journal of Tropical Medicine and Hygiene*, 22, 606–608.
- Kayton, R.J., Kritsky, D.C. & Tobias, R.C. (1979) *Rhabdochona catostomi* sp. n. (Nematoda: Rhabdochonidae) from the intestine of *Catostomus* spp. (Catostomidae). *Proceedings of the Helminthological Society of Washington*, 46, 224–227.
- Khan, R.A. (1985) Larval *Anisakis simplex* (Nematoda: Ascaridoidea) in Atlantic cod, *Gadus morhua*, in the N. W. Atlantic (Labrador-Newfoundland area). *Program and Abstracts. 60th Annual Meeting, American Society of Parasitologists, 04–08 August 1985, Athens, Georgia*. pp. 45–46.
- Khan, R.A. (1991) Effect of oil-contaminated sediment on the longhorn sculpin (*Myoxocephalus octodecemspinosus*) following chronic exposure. *Bulletin of Environmental Contamination and Toxicology*, 47, 63–69.
<http://dx.doi.org/10.1007/bf01689454>

- Khan, R. A. (1999) Length-mass relationship, histopathology, and parasitism in winter flounder (*Pleuronectes americanus*) living near a PCB-contaminated naval facility in Newfoundland. *Canadian Journal of Zoology*, 77, 381–388.
<http://dx.doi.org/10.1139/z98-239>
- Khan, R.A., Barker, D., Hooper, R. & Lee, E.M. (1992) Effect of pulp and paper effluent on a marine fish, *Pseudopleuronectes americanus*. *Bulletin of Environmental Contamination and Toxicology*, 48, 449–456.
<http://dx.doi.org/10.1007/bf00195646>
- Khan, R.A. & Chandra, C.V. (2006) Influence of climatic changes on the parasites of Atlantic cod *Gadus morhua* off coastal Labrador. *Journal of Helminthology*, 80, 193–197.
<http://dx.doi.org/10.1079/joh2006352>
- Khan, R.A., Chandra, C.V. & Earle, P. (2011) Comparison of metazoan parasites of Atlantic cod, *Gadus morhua*, from three geographical areas of coastal Newfoundland. *Journal of Parasitology*, 97, 270–274.
<http://dx.doi.org/10.1645/ge-2510.1>
- Khan, R.A., Dawe, M., Bowering, R. & Misra, R.K. (1982) Blood protozoa as an aid for separating stocks of Greenland halibut, *Reinhardtius hippoglossoides*, in the northwestern Atlantic. *Canadian Journal Fisheries and Aquatic Sciences*, 39, 1317–1322.
<http://dx.doi.org/10.1139/f82-176>
- Khan, R.A. & Tuck, C. (1995) Parasites as biological indicators of stocks of Atlantic cod (*Gadus morhua*) off Newfoundland, Canada. *Canadian Journal of Fisheries and Aquatic Sciences*, 52 (Suppl.), 195–201.
<http://dx.doi.org/10.1139/f95-527>
- Kinnis, P. & Curtis, M.A. (1981) The occurrence of fish parasites in LG-2, a large, newly inundated reservoir in northern Quebec. Program and Abstracts. 20th Annual Meeting, Canadian Society of Zoologists, University of Waterloo, 10–13 May 1981. *Bulletin of the Canadian Society of Zoologists*, 12, p. 63.
- Klimpel, S. & Rückert, S. (2005) Life cycle strategy of *Hysterothylacium aduncum* to become the most abundant anisakid fish nematode in the North Sea. *Parasitology Research*, 97, 141–149.
<http://dx.doi.org/10.1007/s00436-005-1407-6>
- Ko, R.C. (1986) A preliminary review of the genus *Ascarophis* van Beneden, 1871 (Nematoda: Cystidicolidae) of the gastrointestinal tract of fishes. Department of Zoology, University of Hong Kong, Occasional Publications, 54 pp.
- Ko, R.C. & Adams, J.R. (1969) The development of *Philonema oncorhynchi* (Nematoda: Philometridae) in *Cyclops bicuspidatus* in relation to temperature. *Canadian Journal of Zoology*, 47, 307–312.
<http://dx.doi.org/10.1139/z69-062>
- Ko, R.C. & Anderson, R.C. (1969) A revision of the genus *Cystidicola* Fischer, 1798 (Nematoda: Spiruroidea) of the swim-bladders of fishes. *Journal of the Fisheries Research Board of Canada*, 26, 849–864.
<http://dx.doi.org/10.1139/f69-083>
- Kohler, A.C. (1959) Growth and parasites of cod during a year in captivity. *Fisheries Research Board, Progress Reports of the Atlantic Coast Stations*, 72, 2–7.
- Koie, M. (1993) Nematode parasites in teleosts from 0 to 1540 m depth [*sic*] off the Faroe Islands (the North Atlantic). *Ophelia*, 38, 217–243.
<http://dx.doi.org/10.1080/00785326.1993.10429897>
- Koie, M. (2009) *Boreogadus saida* (Lepechin) (Gadidae): a review of its metazoan parasite fauna from Greenland, eastern Canada, Alaska and the Russian Arctic. *Polar Biology*, 32, 1399–1406.
<http://dx.doi.org/10.1007/s00300-009-0650-1>
- Kolasa, K. & Curtis, M. (1995) Seasonal dynamics of helminth parasites in Arctic charr, *Salvelinus alpinus* (L.), from a lake-resident population in northern Quebec, Canada. Proceedings. 3rd International Charr Symposium. 13–18 June 1994, Trondheim, Norway. *Nordic Journal of Freshwater Research*, 71, 345–351.
- Kovalenko, L.M. (1969) [Helminth infections in *Atheresthes stomias*.] In: Voprosy Morskoi Biologii. Tezisy II. Vsesoyuznogo Simpoziuma Molodykh Ucheny, Sevastopol 1969. "Naukova Dumka", Kiev SSSR, pp. 61–62. (In Russian.)
- Krzykawski, S. & Wierbicka, J. (1992) An attempt to determine systematic position of Greenland halibut, *Reinhardtius hippoglossoides* (Walbaum, 1792), from Labrador region and Barents Sea on the basis of morphometric, biologic, and parasitological studies. *Acta Ichthyologica et Piscatoria*, 22, 59–75.
<http://dx.doi.org/10.3750/AIP1992.22.2.04>
- Kuitunen-Ekbaum, E. (1933a) The occurrence of dracontiasis in Pacific coastal fishes. Annual Report on the Work of the Biological Board of Canada for the year 1932, Ottawa, 90 pp.
- Kuitunen-Ekbaum, E. (1933b) *Philonema oncorhynchi* nov. gen. et spec. *Contributions to Canadian Biology and Fisheries, New Series*, 8, 71–75.
<http://dx.doi.org/10.1139/f33-004>
- Kuitunen-Ekbaum, E. (1933c) A case of dracontiasis in Pacific coastal fishes. *Contributions to Canadian Biology and Fisheries, New Series*, 9, 161–168.
<http://dx.doi.org/10.1139/f33-013>
- Kuitunen-Ekbaum, E. (1937a) Notes on the biology and partial life history of the dracunculid, *Philonema oncorhynchi* Kuitunen-Ekbaum. *Fisheries Research Board of Canada Manuscript Report (Biology)*, No. 304, 8 pp.
- Kuitunen-Ekbaum, E. (1937b) Intestinal parasites of haddock in Canadian waters. *Fisheries Research Board of Canada*

- Kuitunen-Ekbaum, E. (1938) A study of the dracunculid nematode, *Philometra americanus* Kuitunen-Ekbaum, with notes on related species. Ph. D. Dissertation, University of Toronto, Toronto, Canada, 117 pp.
- Kussat, R.H. (1966) Bottom fauna studies in relation to the biology of certain fishes of the Bow River. M.Sc. Thesis. Department of Biology, University of Calgary, Calgary, Alberta.
- Kussat, R.H. (1969) A comparison of aquatic communities in the Bow River above and below sources of domestic and industrial wastes from the city of Calgary. *Canadian Fish Culturalist*, 40, 3–31.
- Kuwahara, A., Niimi, A. & Itagaki, H. (1974) Studies on a nematode parasitic in the air bladder of the eel. I. Description of *Anguillicola crassa* [sic] n. sp. (Philometridea, Anguillicolidae). *Japanese Journal of Parasitology*, 23, 275–279.
- Laetsch, D.R., Heitlinger, E.G., Taraschewski, H., Nadler, S.A. & Blaxter, M.L. (2012) The phylogenetics of Anguillicolidae (Nematoda: Anguillicoloidea), swimbladder parasites of eels. *BMC Evolutionary Biology*, 12, 60.
<http://dx.doi.org/10.1186/1471-2148-12-60>
- Landry, T. (1989a) Abundance of sealworm (*Pseudoterranova decipiens*) for inshore areas in the Gulf of St. Lawrence, Canada: the use of American smelt (*Osmerus mordax*) as host indicator. *Program and Abstracts. 64th Annual Meeting, American Society of Parasitologists, University of British Columbia, 06–10 August 1989*, p. 54.
- Landry, T. (1989b) American smelt, *Osmerus mordax*, as host indicator of sealworm, *Pseudoterranova decipiens* abundance in the Gulf of St. Lawrence, Canada. In: Möller, H. (Ed.). *Nematode Problems in North American Fish*. Report from a Workshop in Kiel, 03–04 April 1989. International Council for the Exploration of the Sea. Mariculture Committee. C. M. 1989/F, 37–41.
- Landry, T. (1990a) The use of host and parasitic indicators in fisheries management: parasites of American smelt (*Osmerus mordax*). *Program and Abstracts. 29th Annual Meeting, Canadian Society of Zoologists, Simon Fraser University, 02–05 May 1990. Bulletin of the Canadian Society of Zoologists*, 21, p. 64.
- Landry, T. (1990b) Annual and geographical variations in sealworm (*Pseudoterranova decipiens*) larvae in rainbow smelt (*Osmerus mordax*) from the Gulf of St. Lawrence. *Canadian Technical Report of Fisheries and Aquatic Sciences*, No. 1734, viii + 10 pp.
- Landry, T., Boghen, A.D. & Hare, G.M. (1986) A comparative study of the parasites of alewife *Alosa pseudoharengus* and blueback herring *Alosa aestivalis* from the Miramichi River, N. B. *Program and Abstracts. 25th Annual Meeting, Canadian Society of Zoologists, University of Saskatchewan, 11–14 May 1986. Bulletin of the Canadian Society of Zoologists*, 17, p. 23.
- Landry, T., Boghen, A.D. & Hare, G.M. (1992) Les parasites de l'aloise d'été (*Alosa aestivalis*) et du gaspareau (*Alosa pseudoharengus*) de la rivière Miramichi, New Brunswick. *Canadian Journal of Zoology*, 70, 1622–1624.
<http://dx.doi.org/10.1139/z92-223>
- Landry, T. & Hare, G.M. (1990) Abundance of sealworm, *Pseudoterranova decipiens*, in rainbow smelt (*Osmerus mordax*) from the southwestern Gulf of St. Lawrence. In: Bowen, W. D. (Ed.). *Population Biology of Sealworm (Pseudoterranova decipiens) in Relation to its Intermediate and Seal Hosts*, pp. 199–127. *Canadian Bulletin of Fisheries and Aquatic Sciences*, No. 222, 306 pp.
- Lankester, M.W. & Smith, J.D. (1980) Host specificity and distribution of the swim-bladder nematodes, *Cystidicola farionis* Fischer, 1798 and *C. cristivomeri* White, 1941 (Habronematoidea), in salmonid fishes of Ontario. *Canadian Journal of Zoology*, 58, 1298–1305.
<http://dx.doi.org/10.1139/z80-181>
- Larrat, S., Bouchard, F., Séguin, G. & Lair, S. (2013) Relationship between red vent syndrome and anisakid larvae burden in wild Atlantic salmon (*Salmo salar*). *Journal of Wildlife Diseases*, 49, 229–234.
<http://dx.doi.org/10.7589/2011-10-299>
- Lee, D.L. (Ed.) (2002) *The Biology of Nematodes*. Taylor & Francis, London and New York, xii + 635 pp.
<http://dx.doi.org/10.1017/s0031182002212342>
- Lee, D.L., Whitaker, D. J. & Stanley, R.D. (1990) A preliminary examination of the parasite fauna of yellowtail rockfish, *Sebastes flavidus*. *Canadian Technical Report of Fisheries and Aquatic Sciences*, 1777, 21 pp.
- Lee, E.M. (1988) Commercial cod farming operations, Newfoundland 1988. *Canadian Industry Reports of Fisheries and Aquatic Sciences*, No. 201, vii + 52 pp.
- Lee, E.M. & Khan, R.A. (2000) Length-weight-age relationships, food, and parasites of Atlantic cod (*Gadus morhua*) off coastal Labrador within NAFO divisions 2H and 2J-3K. *Fisheries Research*, 45, 65–72.
[http://dx.doi.org/10.1016/s0165-7836\(99\)00101-0](http://dx.doi.org/10.1016/s0165-7836(99)00101-0)
- Leidy, J. (1886) Notices of nematoid worms. *Proceedings of the Academy of Natural Sciences of Philadelphia*, 38, 308–313.
- Leong, T.S. (1975) Metazoan parasites of fishes of Cold Lake, Alberta: a community analysis. Ph. D. Dissertation. Department of Zoology, University of Alberta, Edmonton, Alberta, 170 pp.
- Leong, T.S. & Holmes, J.C. (1974) Acquisition of helminths by coho salmon, *Oncorhynchus kisutch*, introduced into Cold Lake, Alberta: a comparison with helminths of native salmonid fish. *Proceedings. 3rd International Congress of Parasitology, 25–31 August 1974, Munich, Federal Republic of Germany*, 3, p. 1639.
- Leong, T.S. & Holmes, J.C. (1981) Communities of metazoan parasites in open water fishes of Cold Lake, Alberta. *Journal of Fish Biology*, 18, 693–713.
<http://dx.doi.org/10.1111/j.1095-8649.1981.tb03811.x>

- Lester, R.J.G. (1974) Parasites of *Gasterosteus aculeatus* near Vancouver, British Columbia. *Syesis*, 7, 195–200.
- Lewis, J.W. (1973) Internal pressure changes in the dracunculoid nematode *Philonema oncorhynchi*. *Parasitology*, 67, xv–xvi.
<http://dx.doi.org/10.1017/s0031182000063095>
- Lewis, J.W. (1978) Mechanism of larval release in dracunculoid nematodes. *Parasitology*, 77, vi.
- Lewis, J.W., Jones, D.R. & Adams, J.R. (1974) Functional bursting by the dracunculoid nematode *Philonema oncorhynchi*. *Parasitology*, 69, 417–427.
<http://dx.doi.org/10.1017/s0031182000063095>
- Li, W., Arnott, S.A., Jones, K.M.M., Braicovich, P.E., de Buron, I., Wang, G. & Marcogliese, D.J. (2015) First record of paratenic hosts of the swimbladder nematode *Anguillicola crassus* in North America. *Journal of Parasitology* 101, 529–535.
<http://dx.doi.org/10.1645/15-774>
- Lichtenfels, J.R. (1980a) Keys to the Genera of the Superfamily Strongyloidea. In: Anderson, R. C., Chabaud, A.G. & Willmott, S. (Eds.), *CIH Keys to the Nematode Parasites of Vertebrates*. No. 7, 41 pp. Commonwealth Agricultural Bureaux, Farnham Royal, Bucks, England.
- Lichtenfels, J.R. (1980b) Keys to the Genera of the Superfamilies Ancylostomatoidea and Diaphanocephaloidea. In: Anderson, R.C., Chabaud, A.G. & Willmott, S. (Eds.), *CIH Keys to the Nematode Parasites of Vertebrates*. No. 8, 26 pp. Commonwealth Agricultural Bureaux, Farnham Royal, Bucks, England.
- Likely, C.G. & Burt, M.D.B. (1989) Cultivation of *Pseudoterranova decipiens* (sealworm) from third-stage to egg-laying adults in vitro. *Canadian Journal of Fisheries and Aquatic Sciences*, 46, 1095–1096.
<http://dx.doi.org/10.1139/f89-141>
- Likely, C.G. & Burt, M.D.B. (1992) *In vitro* cultivation of *Contracaecum osculatum* (Nematoda: Anisakidae) from third-stage to egg-laying adults. *Canadian Journal of Fisheries and Aquatic Sciences*, 49, 347–348.
<http://dx.doi.org/10.1139/f92-039>
- Linkletter, L.E., Lord, E.L. & Dadswell, M.J. (1977) *A checklist and catalogue of the marine fauna and flora of the lower Bay of Fundy shore of New Brunswick*. Huntsman Marine Laboratory, St. Andrews, New Brunswick, vii + 68 pp.
- Linton, E. (1901) Parasites of fishes in the Woods Hole region. *Bulletin of the United States Fisheries Commission*, 19, 405.
- Liston, J. & Hitz, C.R. (1961) Second survey of the occurrence of parasites and blemishes in Pacific Ocean perch, *Sebastes alutus*, May–June 1959. *United States Fish and Wildlife Service, Special Scientific Reports, Fisheries*, No. 383, 6 pp.
- Liston, J., Peters, J. & Stern, J.A. (1960) Parasites in summer-caught Pacific rockfishes. *United States Fish and Wildlife Service, Special Scientific Reports, Fisheries*, No. 352, 10 pp.
- Luo, H.-Y., Chen, H.-Y., Chen, H.-G. & Shih, H.-H. (2016) Scavenging hagfish as a transport host of Anisakid nematodes. *Veterinary Parasitology*, 218, 15–21.
<http://dx.doi.org/10.1016/j.vetpar.2016.01.005>
- Luque, J.L., Bannock, L.M., Lagrue, C. & Poulin, R. (2007) Larval *Hysterothylacium* sp. (Nematoda, Anisakidae) and trematode metacercariae from the amphipod *Paracorophium excavatum* (Cotrophiidae) in New Zealand. *Acta Parasitologica*, 52, 146–150.
<http://dx.doi.org/10.2478/s11686-007-0022-3>
- Lyster, L.L. (1940) Parasites of freshwater fish. II. Parasitism of speckled and lake trout and the fish found associated with them in Lake Commandant, Quebec. *Canadian Journal of Research, Section D*, 18, 66–78.
<http://dx.doi.org/10.1139/cjr40d-005>
- Mace, T.F. & Anderson, R.C. (1975) Development of the giant kidney worm, *Diectophyma renale* (Goeze, 1782) (Nematoda: Diectophymatoidea). *Canadian Journal of Zoology*, 53, 1552–1558.
<http://dx.doi.org/10.1139/z75-190>
- Mackie, G.L., Morton, W.B. & Ferguson, M.S. (1983) Fish parasitism in a new impoundment and differences upstream and downstream. *Hydrobiologia*, 99, 197–205.
<http://dx.doi.org/10.1007/bf00008771>
- MacKinnon, B.M. & Burt, M.D.B. (1992) Functional morphology of the female reproductive tract of *Pseudoterranova decipiens* (Nematoda) raised in vivo and in vitro. *Zoomorphology*, 112, 237–245.
<http://dx.doi.org/10.1007/bf01632821>
- MacLulich, D.A. (1943) Parasites of trout in Algonquin Provincial Park, Ontario. *Canadian Journal of Research, Section D*, 21, 405–412.
<http://dx.doi.org/10.1139/cjr43d-033>
- Maggenti, A.R. (1971) A review of the family Cucullanidae Cobbold, 1864 and the genus *Bulbodacnitis* Lane, 1916 with a description of *Bulbodacnitis* sp. n. (Nematoda: Cucullanidae) from *Salmo gairdneri* Richardson. *Proceedings of the Helminthological Society of Washington*, 38, 80–85.
- Malmberg, G. & Afzelius, B.A. (1990) Sperm ultrastructure in *Myxinidocotyle* and *Acanthocotyle* (Platyhelminthes, Monogenea, Acanthocotylidae). *Zoologica Scripta*, 19, 129–132.
<http://dx.doi.org/10.1111/j.1463-6409.1990.tb00245.x>
- Malouf, A.H. (1986) Transmission of parasites. *Report of the Royal Commission on Seals and the Sealing Industry in Canada. Seals and Sealing in Canada* Vol. 3, Part Vb. Chapter 26. Minister of Supply and Services, Ottawa. pp. 399–455.
- Marcogliese, D.J. (1991) Occurrence of the larval stages of the seal parasites *Corynosoma wegneri* and *Pseudoterranova*

- decipiens* in fishes on the Scotian Shelf, northwestern Atlantic Ocean. *Program and Abstracts. 66th Annual Meeting, American Society of Parasitologists, 04–08 August 1991*, University of Wisconsin, Madison, p. 7.
- Marcogliese, D.J. (1992a) *Neomysis americana* (Crustacea: Mysidacea) as an intermediate host for sealworm, *Pseudoterranova decipiens* (Nematoda: Ascaridoidea), and spirurid nematodes (Acuarioidea). *Canadian Journal of Fisheries and Aquatic Sciences*, 49, 513–515.
<http://dx.doi.org/10.1139/f92-060>
- Marcogliese, D.J. (1992b) Metazoan parasites of sticklebacks on Sable Island, northwest Atlantic Ocean: biogeographic considerations. *Journal of Fish Biology*, 41, 399–407.
<http://dx.doi.org/10.1111/j.1095-8649.1992.tb02668.x>
- Marcogliese, D.J. (1995a) Geographic and temporal variations in levels of anisakid nematode larvae among fishes in the Gulf of St. Lawrence, eastern Canada. *Canadian Technical Report of Fisheries and Aquatic Sciences*, No. 2029, vii + 16 pp.
- Marcogliese, D.J. (1995b) Comparison of parasites of mummichogs and sticklebacks from brackish and freshwater ponds on Sable Island, Nova Scotia. *American Midland Naturalist*, 133, 333–343.
<http://dx.doi.org/10.2307/2426398>
- Marcogliese, D.J. (1996) Transmission of the sealworm, *Pseudoterranova decipiens* (Krabbe), from invertebrates to fish in an enclosed brackish pond. *Journal of Experimental Marine Biology and Ecology*, 205, 205–219.
[http://dx.doi.org/10.1016/s0022-0981\(96\)02613-5](http://dx.doi.org/10.1016/s0022-0981(96)02613-5)
- Marcogliese, D.J., Albert, E., Gagnon, P. & Sevigny, J.-M. (2003) Use of parasites in stock identification of the deepwater redfish (*Sebastes mentella*) in the Northwest Atlantic. *Fisheries Bulletin*, 101, 183–188.
- Marcogliese, D.J., Ball, B. & Lankester, M.W. (2001) Potential impacts of clearcutting on parasites of minnows in small boreal lakes. *Folia Parasitologica*, 48, 269–274.
<http://dx.doi.org/10.14411/fp.2001.045>
- Marcogliese, D.J. & Boily, F. (1994) Changes in abundances of anisakid nematodes in Atlantic cod and grey seals in the Gulf of St. Lawrence. *Program and Abstracts. 69th Annual Meeting, American Society of Parasitologists, 09–13 August 1994*, Fort Collins, Colorado, p. 61.
- Marcogliese, D.J., Brambilla, L.G., Gagné, F. & Gendron, A. (2005) Joint effects of parasitism and pollution on oxidative stress biomarkers in yellow perch *Perca flavescens*. *Diseases of Aquatic Organisms*, 63, 77–84.
<http://dx.doi.org/10.3354/dao063077>
- Marcogliese, D.J. & Cone, D.K. (1991a) Do brook charr (*Salvelinus fontinalis*) from insular Newfoundland have different parasites than their mainland counterparts? *Canadian Journal of Zoology*, 69, 809–811.
<http://dx.doi.org/10.1139/z91-119>
- Marcogliese, D.J. & Cone, D.K. (1991b) Importance of lake characteristics in structuring parasite communities of salmonids from insular Newfoundland. *Canadian Journal of Zoology*, 69, 2962–2967.
<http://dx.doi.org/10.1139/z91-417>
- Marcogliese, D.J. & Cone, D.K. (1996) On the distribution and abundance of eel parasites in Nova Scotia: influence of pH. *Journal of Parasitology*, 82, 389–399.
<http://dx.doi.org/10.2307/3284074>
- Marcogliese, D.J. & Cone, D.K. (1998) Comparison of richness and diversity of macroparasite communities among eels from Nova Scotia, the United Kingdom and Australia. *Parasitology*, 116, 73–83.
<http://dx.doi.org/10.1017/s0031182097001923>
- Marcogliese, D.J., Gendron, A. D. & Dumont, P. (2009) Parasites of illegally introduced tench (*Tinca tinca*) in the Richelieu River, Quebec, Canada. *Comparative Parasitology*, 76, 222–228.
<http://dx.doi.org/10.1654/4362.1>
- Marcogliese, D.J. & McClelland, G. (1992) *Corynosoma wegneri* (Acanthocephala: Polymorphida) and *Pseudoterranova decipiens* (Nematoda: Ascaridoidea) larvae in Scotian Shelf groundfish. *Canadian Journal of Fisheries and Aquatic Sciences*, 49, 2062–2069.
<http://dx.doi.org/10.1139/f92-229>
- Margolis, L. (1952a) Unpublished data. Institute of Parasitology, McGill University, Montreal, Quebec.
- Margolis, L. (1952b) Studies on the parasites and diseases of marine and anadromous fish from the Canadian Pacific coast. Ph. D. Dissertation, Institute of Parasitology, McGill University, Montreal, Quebec.
- Margolis, L. (1956) Report on parasite studies of sockeye and pink salmon collected in 1955, with special reference to the utilization of parasites as a means of distinguishing between Asiatic and American stocks of salmon on the high seas – a progress report on work being carried out as part of F.R.B.'s commitments to INPFC. *Fisheries Research Board of Canada Manuscript Report (Biology)*, No. 624, 36 pp.
- Margolis, L. (1957) A study of the parasites of sockeye and pink salmon with particular reference to their application in distinguishing between Asiatic and North American stocks of these fishes on the high seas – report of results of examination of 1956 samples. *Fisheries Research Board of Canada Manuscript Report (Biology)*, No. 641, 24 pp.
- Margolis, L. (1960) A new nematode of the genus *Cucullanus* (Camallanata: Cucullanidae) from a flounder, *Parophrys vetulus* Girard, 1854, with notes on the species from Pleuronectiformes. *Canadian Journal of Zoology*, 38, 839–850.
<http://dx.doi.org/10.1139/z60-088>
- Margolis, L. (1963) Parasites as indicators of the geographical origin of sockeye salmon, *Oncorhynchus nerka* (Walbaum),

- occurring in the North Pacific Ocean and adjacent seas. *International North Pacific Fisheries Commission Bulletin*, No. 11, 101–156.
- Margolis, L. (1965) Parasites as an auxiliary source of information about the biology of Pacific salmon (genus *Oncorhynchus*). *Journal of the Fisheries Research Board of Canada*, 22, 1387–1395.
<http://dx.doi.org/10.1139/f65-122>
- Margolis, L. (1966) The swim bladder nematodes of Pacific salmon (genus *Oncorhynchus*). *Proceedings of the 1st International Congress of Parasitology, 21–26 September 1964, Rome, Italy*, pp. 559–560.
<http://dx.doi.org/10.1016/b978-1-4832-2913-3.50448-2>
- Margolis, L. (1967a) The swim bladder nematodes (Cystidicolinae) of Pacific salmon (genus *Oncorhynchus*). *Canadian Journal of Zoology*, 45, 1183–1199.
<http://dx.doi.org/10.1139/z67-127>
- Margolis, L. (1967b) Blood feeding in *Salvelinema walkeri* (Nematoda: Cystidicolinae), a parasite of coho salmon (*Oncorhynchus kisutch*). *Canadian Journal of Zoology*, 45, 1295–1296.
<http://dx.doi.org/10.1139/z67-144>
- Margolis, L. (1970) Nematode diseases of marine fishes. In: Snieszko, S.F. (Ed.), *A Symposium on Diseases of Fishes and Shellfishes*. American Fisheries Society Special Publication, No. 5, pp. 190–208.
- Margolis, L. (1977) *Caballeronema* gen. nov. for *Metabronema wardlei* Smedley, 1934 (Nematoda: Spiruroidea) from the marine fish *Scorpaenichthys marmoratus* from the Pacific coast of Canada. *Excerta Parasitologia en Memoria del Doctor Eduardo Caballero y Caballero. Universidad Nacional Autonoma de Mexico, Instituto de Biologia, Publicaciones Especiales*, 4, 447–454.
- Margolis, L. (1982) Parasitology of Pacific salmon – an overview. In: Meerovitch, E. (Ed.) *Aspects of Parasitology – a Festschrift dedicated to the 50th Anniversary of the Institute of Parasitology of McGill University, 1932–1982*. McGill University, Montreal, Canada, pp. 135–226.
<http://dx.doi.org/10.1017/s0031182000054895>
- Margolis, L. (1984) Preliminary report on identification of continent of origin of ocean-caught steelhead trout, *Salmo gairdneri*, using naturally occurring parasite "tags". Unpublished Report. Canada Department of Fisheries and Oceans. Fisheries Research Branch, Pacific Biological Station, 23 pp.
- Margolis, L. & Arthur, J.R. (1979) Synopsis of the Parasites of Fishes of Canada. *Bulletin of the Fisheries Research Board of Canada*, No. 199, 269 pp.
- Margolis, L. & Beverley-Burton, M. (1977) Response of mink (*Mustela vison*) to larval *Anisakis simplex* (Nematoda: Ascaridida). *International Journal for Parasitology*, 7, 269–273.
[http://dx.doi.org/10.1016/0020-7519\(77\)90034-0](http://dx.doi.org/10.1016/0020-7519(77)90034-0)
- Margolis, L. & Kabata, Z. (1967) The structure of the buccal region of *Salvelinema* Trofimenko, 1967 (Nematoda: Cystidicolinae). *Canadian Journal of Zoology*, 45, 1067–1072.
<http://dx.doi.org/10.1139/z67-116>
- Margolis, L. & Kabata, Z. (1984) General Introduction, p. 1–4. In: Margolis, L. & Kabata, Z. (Eds.), *Guide to the Parasites of Fishes of Canada. Part I*. Canadian Special Publication of Fisheries and Aquatic Sciences, 74, 209 pp.
<http://dx.doi.org/10.1017/s0022149x00008087>
- Margolis, L. & McDonald, T.E. (1986) Parasites of white sturgeon, *Acipenser transmontanus*, from the Fraser River, British Columbia. *Journal of Parasitology*, 72, 794–796.
<http://dx.doi.org/10.2307/3281484>
- Margolis, L. & Moravec, F. (1982) *Ramellogammarus vancouverensis* Bousfield (Amphipoda) as an intermediate host for salmonid parasites in British Columbia. *Canadian Journal of Zoology*, 60, 1100–1104.
<http://dx.doi.org/10.1139/z82-152>
- Margolis, L. & Moravec, F. (1987) A record of *Clavinema mariae* (Layman, 1930) (Nematoda: Philometridae) from a North American freshwater fish, with notes on the systematic status of *Philometra americanus* Kuitunen-Ekbaum, 1933. *Folia Parasitologica*, 34, 31–36.
- Margolis, L., Moravec, F. & McDonald, T.E. (1975) *Rhabdochona kisutchi* sp. nov. (Nematoda: Spiruroidea) from coho salmon, *Oncorhynchus kisutch* (Walbaum), of western Canada. *Canadian Journal of Zoology*, 53, 960–966.
<http://dx.doi.org/10.1139/z75-111>
- Martell, D.J. & McClelland, G. (1995) Transmission of *Pseudoterranova decipiens* (Nematoda: Ascaridoidea) via benthic macrofauna to sympatric flatfishes (*Hippoglossoides platessoides*, *Pleuronectes ferrugineus*, *P. americanus*) on Sable Island Bank, Canada. *Marine Biology*, 122, 129–135.
<http://dx.doi.org/10.1007/bf00349286>
- Martin, W.R. (1953) Appendix 38. Cod-worm investigation – removal of worms from fillets. In: Needler, A.W.H. (Ed.), *Fisheries Research Board of Canada. Report of the Atlantic Biological Station for 1953*, pp. 72–73.
- Marty, G.D. (2008) Anisakid larva in the viscera of a farmed Atlantic salmon (*Salmo salar*). *Aquaculture*, 279, 209–210.
<http://dx.doi.org/10.1016/j.aquaculture.2008.04.006>
- Mattiucci, S. & Nascetti, G. (2007) Genetic diversity and infection levels of anisakid nematodes parasitic in fish and marine mammals from Boreal and Austral hemispheres. *Veterinary Parasitology*, 148, 43–57.
<http://dx.doi.org/10.1016/j.vetpar.2007.05.009>

- Mattiucci, S. & Nascetti, G. (2008) Advances and trends in the molecular systematics of anisakid nematodes, with implications for their evolutionary ecology and host-parasite coevolutionary processes. *Advances in Parasitology*, 66, 47–148.
[http://dx.doi.org/10.1016/S0065-308X\(08\)00202-9](http://dx.doi.org/10.1016/S0065-308X(08)00202-9)
- Mattiucci, S. & Paggi, L. (1989) Multilocus electrophoresis for the identification of larval *Anisakis simplex* A and B and *Pseudoterranova decipiens* A, B and C from fish. In: Möller, H. (Ed.), *Nematode problems in North Atlantic Fish*. Report from a Workshop in Kiel, 03–04 April 1989. International Council for the Exploration of the Sea. Mariculture Committee, 1989/F, 6, 23.
- Mattiucci, S., Cianchi, R., Nascetti, G., Paggi, L., Sardella, N., Timi, J., Webb, S.C., Bastida, R. & Bullini, L. (2003) Genetic evidence for two sibling species within *Contracaecum ogmorhini* Johnston & Mawson, 1941 (Nematoda: Anisakidae) from otariid seals of boreal and austral regions. *Systematic Parasitology*, 54, 13–23.
<http://dx.doi.org/10.1023/a:1022145926409>
- Mattiucci, S., Nascetti, G., Cianchi, R., Paggi, L., Arduino, L., Margolis, L., Bratley, J., Webb, S., D'Amelio, S., Orecchia, P. & Bullini, L. (1997) Genetic and ecological data on the *Anisakis simplex* complex, with evidence for a new species (Nematoda, Ascaridoidea, Anisakidae). *Journal of Parasitology*, 83, 401–416.
<http://dx.doi.org/10.2307/3284402>
- Mattiucci, S., Paggi, L., Nascetti, G., D'Amelio, S. & Orecchia, P. (1996) Nuovi dati su ospiti e distribuzione geografica di specie del genere *Anisakis* Dujardin, 1845 (Ascaridida: Anisakidae) e nuove segnalazioni in grandi pelagici del Mediterraneo. *Biologia Marina Mediterranea*, 3, 377–379.
- Mattiucci, S., Paggi, L., Nascetti, G., Ishikura, H., Kikuchi, K., Sato, N., Cianchi, R. & Bullini, L. (1998) Allozyme and morphological identification of *Anisakis*, *Contracaecum* and *Pseudoterranova* from Japanese waters (Nematoda: Ascaridoidea). *Systematic Parasitology*, 40, 81–92.
<http://dx.doi.org/10.1023/a:1005914926720>
- McAllister, D.J. & Mudry, D.R. (1983) Diseases and Parasites of Alberta Fishes and Potential Consequences of their Interbasin Transfer. Prepared for the Alberta Environmental Research Trust by Techman Inc., Calgary, Alberta, 80 pp.
- McClelland, G. (1976) *Terranova decipiens* (Nematoda: Anisakinae): course of infection and pathology in seal hosts. *Transactions of the American Microscopical Society*, 95, 265.
- McClelland, G. (1980a) *Phocanema decipiens*: molting in seals. *Experimental Parasitology*, 49, 128–136.
[http://dx.doi.org/10.1016/0014-4894\(80\)90065-x](http://dx.doi.org/10.1016/0014-4894(80)90065-x)
- McClelland, G. (1980b) *Phocanema decipiens*: growth, reproduction and survival in seals. *Experimental Parasitology*, 49, 175–187.
[http://dx.doi.org/10.1016/0014-4894\(80\)90115-0](http://dx.doi.org/10.1016/0014-4894(80)90115-0)
- McClelland, G. (1980c) *Phocanema decipiens*: pathology in seals. *Experimental Parasitology*, 49, 405–419.
[http://dx.doi.org/10.1016/0014-4894\(80\)90075-2](http://dx.doi.org/10.1016/0014-4894(80)90075-2)
- McClelland, G. (1995) Experimental infection of fish with larval sealworm, *Pseudoterranova decipiens* (Nematoda: Anisakinae), transmitted by amphipods. *Canadian Journal of Fisheries and Aquatic Sciences*, 52 (Suppl. 1), 140–155.
<http://dx.doi.org/10.1139/f95-520>
- McClelland, G. (2000) Natural transmission of larval sealworm, *Pseudoterranova decipiens*, to juvenile Canadian plaice, *Hippoglossoides platessoides*, and other small benthic consumers. Program and Abstracts. 39th Annual Meeting, Canadian Society of Zoologists, Huntsman Marine Science Centre, St Andrews, New Brunswick, 02–06 May 2000. *Bulletin of the Canadian Society of Zoologists*, 31, 83–84.
- McClelland, G. & Marcogliese, D.J. (1994) Larval anisakine nematodes as biological indicators of cod (*Gadus morhua*) populations in the southern Gulf of St. Lawrence and on the Breton Shelf, Canada. Proceedings. Symposium on Parasites of Biological and Economic Significance in the Aquatic Environment – Thirty Years of Research and Future Trends. SSP PARAQua'94: Scandinavian Society for Parasitology, Heimaey, Westman Islands, Iceland. (H.-P. Fagerholm & E. J. Hauksson, Eds.) *Bulletin of the Scandinavian Society for Parasitology*, 4, 97–116.
- McClelland, G. & Martell, D. J. (2001a) Surveys of larval sealworm (*Pseudoterranova decipiens*) infections in various fish species sampled from Nova Scotian waters between 1988 and 1996, with an assessment of examination procedures. In: Desportes, C. & McClelland, G. (Eds.), *Sealworms in the North Atlantic: Ecology and Population Dynamics*. NAMMCO Scientific Publications, 3, 57–76.
<http://dx.doi.org/10.7557/3.2959>
- McClelland, G. & Martell, D.J. (2001b) Spatial and temporal distributions of larval sealworm, *Pseudoterranova decipiens* (Nematoda: Anisakinae), in *Hippoglossoides platessoides* (Pleuronectidae) in the Canadian Maritime Region from 1993 to 1999. In: Desportes, C. & McClelland, G. (Eds.), *Sealworms in the North Atlantic: Ecology and Population Dynamics*. NAMMCO Scientific Publications, 3, 77–94.
<http://dx.doi.org/10.7557/3.2960>
- McClelland, G. & Melendy, J. (2011) Use of parasites as tags in delineating stocks of Atlantic cod (*Gadus morhua*) from the southern Gulf of St. Lawrence and the Cape Breton Shelf. *Fisheries Research*, 107, 233–238.
<http://dx.doi.org/10.1016/j.fishres.2010.10.022>
- McClelland, G., Melendy, J., Osborne, J., Reid, D. & Douglas, S. (2005) Use of parasite and genetic markers in delineating populations of winter flounder from the central and south-west Scotian Shelf and north-east Gulf of Maine. *Journal of Fish Biology*, 66, 1082–1100.

<http://dx.doi.org/10.1111/j.0022-1112.2005.00659.x>

- McClelland, G., Misra, R.K. & Marcogliese, D.J. (1983a) Variations in abundance of larval anisakines, sealworm (*Phocanema decipiens*) and related species in cod and flatfish from the southern Gulf of St. Lawrence (4T) and the Breton Shelf (4Vn). *Canadian Technical Report of Fisheries and Aquatic Sciences*, No. 1201, 51 pp.
- McClelland, G., Misra, R.K. & Marcogliese, D.J. (1983b) Variations in abundance of larval anisakines, sealworm (*Phocanema decipiens*) and related species in Scotian Shelf (4VS and 4W) cod and flatfish. *Canadian Technical Report of Fisheries and Aquatic Sciences*, No. 1202, 27 pp.
- McClelland, G., Misra, R.K. & Marcogliese, D.J. (1984) Variation de l'abondance des nématode anisakines, du ver de phoque (*Phocanema decipiens*) et des espèces apparentées chez morue et les poissons plats du plateau Scotian (4Vs et 4W). *Canadian Technical Report of Fisheries and Aquatic Sciences*, No. 1202, 29 pp.
- McClelland, G., Misra, R.K. & Martell, D.J. (1985) Variation in abundance of larval anisakines, sealworm (*Pseudoterranova decipiens*) and related species in cod and flatfish. *Canadian Technical Report of Fisheries and Aquatic Sciences*, No. 1392, 57 pp.
- McClelland, G., Misra, R.K. & Martell, D.J. (1987) Temporal and geographic variation in abundance of larval sealworm, *Pseudoterranova* (*Phocanema*) *decipiens* in the fillets of American plaice (*Hippoglossoides platessoides*) in eastern Canada: 1985–1986 surveys. *Canadian Technical Report of Fisheries and Aquatic Sciences*, No. 1513, 15 pp.
- McClelland, G., Misra, R.K. & Martell, D.J. (1990) Larval anisakine nematodes in various fish species from Sable Island Bank and vicinity. In: Bowen, W.D. (Ed.). Population Biology of Sealworm (*Pseudoterranova decipiens*) in Relation to its Intermediate and Seal Hosts: p. 83–118. *Canadian Bulletin of Fisheries and Aquatic Sciences*, No. 222, 306 pp.
- McClelland, G., Misra, R.K. & Martell, D.J. (2000) Spatial and temporal distributions of larval sealworm (*Pseudoterranova decipiens*, Nematoda: Anisakinae), in *Hippoglossoides platessoides* (Pleuronectidae) in eastern Canada from 1980 to 1990. *ICES Journal of Marine Sciences*, 57, 69–88.
<http://dx.doi.org/10.1006/jmsc.1999.0518>
- McClelland, G. & Ronald, K. (1974) *In vitro* development of *Terranova decipiens* (Nematoda) (Krabbe, 1878). *Canadian Journal of Zoology*, 52, 471–479.
<http://dx.doi.org/10.1139/z74-058>
- McCracken, F.D. & Fitzgerald, D.N. (1964) Estimates of incidence of larval nematodes in cod fillets from the southern Canadian mainland in 1963. *Fisheries Research Board of Canada Manuscript Report Series (Biology)*, No. 781, 10 pp.
- McDonald, T.E. & Margolis, L. (1995) Synopsis of the Parasites of Canada: Supplement (1978–1995). *Canadian Special Publication of Fisheries and Aquatic Sciences*, No. 122, 265 pp.
- McDonald, T.E., Lane, E.D., Dalziel, F., Swiatkiewicz, V.J. & Margolis, L. (1989) Recoveries in 1985 and 1986 and releases in 1986 of tagged Fraser River white sturgeon, *Acipenser transmontanus*, together with data on the number of dorsal scutes and the number of *Cystoopsis acipenseris* (Nematoda) present on some of the fish caught in 1986. *Canadian Data Report of Fisheries and Aquatic Sciences*, No. 742, 33 pp.
- McGladdery, S.E. (1981) A survey of parasites of northwest Atlantic herring, *Clupea harengus* L.: a preliminary account. *Northwest Atlantic Fisheries Organization, Science Research Document*. 81/IX/124, Serial No. N430, 20 pp.
- McGladdery, S.E. (1984) Studies of the parasite fauna of Atlantic herring (*Clupea harengus* L.) from the northwestern Atlantic Ocean. Ph. D. Thesis. Department of Biology, University of New Brunswick, Fredericton, New Brunswick, 286 pp.
- McGladdery, S.E. (1986a) *Anisakis simplex* (Nematoda: Anisakidae) infection of the musculature and body cavity of Atlantic herring (*Clupea harengus harengus*). *Canadian Journal of Fisheries and Aquatic Sciences*, 43, 1312–1317.
<http://dx.doi.org/10.1139/f86-164>
- McGladdery, S.E. (1986b) *Anisakis simplex* infection of the fillets and body cavity of Canadian Atlantic herring (*Clupea harengus*) and the public health implications. Program. 25th Annual Meeting, Canadian Society of Zoologists. *Bulletin of the Canadian Society of Zoologists*, 17, 23.
- McGladdery, S.E. & Burt, M.D.B. (1985) Potential of parasites for use as biological indicators of migration, feeding, and spawning behavior of northwest Atlantic herring (*Clupea harengus*). *Canadian Journal of Fisheries and Aquatic Sciences*, 42, 1957–1968.
<http://dx.doi.org/10.1139/f85-243>
- McLeod, J.A. (1943) Preliminary biological investigations of eight lakes in the Whiteshell Forestry Reserve. Manitoba Department of Mines and Natural Resources. *Game and Fisheries Branch Report. Sections A-H*, 107 pp.
- McLeod, J.A. (1944) Biological investigation of Lake Wellman. Manitoba Department of Mines and Natural Resources. *Game and Fisheries Branch Report*, 15 pp.
- Measures, L.N. (1987) Intermediate hosts and epizootiology of *Eustrongylides tubifex* (Nematoda: Dioctophymatoidea) in an eutrophic ecosystem. *Program and Abstracts. 62nd Annual Meeting, American Society of Parasitologists, 02–05 August 1987*, Lincoln, Nebraska, p. 21.
- Measures, L.N. (1988a) Revision of the genus *Eustrongylides* Jagerskiöld, 1909 (Nematoda: Dioctophymatoidea) of piscivorous birds. *Canadian Journal of Zoology*, 66, 885–895.
<http://dx.doi.org/10.1139/z88-131>
- Measures, L.N. (1988b) Epizootiology, pathology and description of *Eustrongylides tubifex* (Nematoda: Dioctophymatoidea) in fish. *Canadian Journal of Zoology*, 66, 2212–2222.
<http://dx.doi.org/10.1139/z88-329>

- Measures, L.N. (1988c) The development and pathogenesis of *Eustrongylides tubifex* (Nematoda: Dioctophymatoidea) in piscivorous birds. *Canadian Journal of Zoology*, 66, 2223–2232.
<http://dx.doi.org/10.1139/z88-330>
- Measures, L.N. & Anderson, R.C. (1985) Centrarchid fishes as paratenic hosts of the giant kidney worm, *Dioctophyme renale* (Goeze, 1782), in Ontario, Canada. *Journal of Wildlife Diseases*, 21, 11–19.
<http://dx.doi.org/10.7589/0090-3558-21.1.11>
- Mejía-Madrid, H.H., Choudhury, A. & Pérez-Ponce De León, G. (2007) Phylogeny and biogeography of *Rhabdochona* Railliet, 1916 (Nematoda: Rhabdochonidae) species from the Americas. *Systematic Parasitology*, 67, 1–18.
<http://dx.doi.org/10.1007/s11230-006-9065-3>
- Melendy, J., McClelland, G. & Hurlbut, T. (2005) Use of parasite tags in delineating stocks of white hake (*Urophycis tenuis*) from the southern Gulf of St. Lawrence and Cape Breton Shelf. *Fisheries Research*, 76, 392–400.
<http://dx.doi.org/10.1016/j.fishres.2005.07.006>
- Meredith, J.E. (1966) Some aspects of the host reaction to the dracunculoid nematode, *Philonema* sp. B. Sc. Thesis. Department of Zoology, University of British Columbia, Vancouver, British Columbia. 31 pp.
- Miller, R.B. (1944) Fish parasites collected at Great Slave Lake in 1944. MS Rep. Department of Zoology, University of Alberta. Edmonton, Alberta. 4 pp.
- Miller, R.B. (1945) Parasites collected from fishes of Lake Athabasca and Great Slave Lake in 1945. Department of Zoology, University of Alberta. Edmonton, Alberta. Unpublished Report. 9 pp.
- Miller, R.B. (1946) Notes on the Arctic grayling, *Thymallus signifer*, from Great Bear Lake. *Copeia*, 4, 227–236.
<http://dx.doi.org/10.2307/1438109>
- Miller, R.B. & Kennedy, W. A. (1948) Observations on the lake trout of Great Bear Lake. *Journal of the Fisheries Research Board of Canada*, 7, 176–189.
<http://dx.doi.org/10.1139/f47-019>
- Miller, S.E. (2007) DNA barcoding and the renaissance of taxonomy. *Proceedings of the National Academy of Sciences of the United States of America*, 104, 4775–4776.
<http://dx.doi.org/10.1073/pnas.0700466104>
- Miscampbell, A.M., Lankester, M.W. & Adamson, M.L. (2004) Molecular and morphological variation within swim bladder nematodes, *Cystidicola* spp. *Canadian Journal of Fisheries and Aquatic Sciences*, 61, 1143–1152.
<http://dx.doi.org/10.1139/f04-064>
- Molnár, K., Chan, G.-L. & Fernando, C. H. (1982) Some remarks on the occurrence and development of philometrid nematodes infecting the white sucker, *Catostomus commersoni* Lacépède (Pisces: Catostomidae) in Ontario. *Canadian Journal of Zoology*, 60, 443–451.
<http://dx.doi.org/10.1139/z82-060>
- Molnár, K. & Fernando, C.H. (1975a) Morphology and development of *Philometra cylindracea* (Ward and Magath, 1916) (Nematoda: Philometridae). *Journal of Helminthology*, 49, 19–24.
<http://dx.doi.org/10.1017/s0022149x0002321x>
- Molnár, K. & Fernando, C.H. (1975b) *Philometra kobuleji* sp. n. (Nematoda: Philometridae). *Journal of Helminthology*, 49, 101–105.
<http://dx.doi.org/10.1017/s0022149x0002321x>
- Molnár, K., Hanek, G. & Fernando, C.H. (1974) Parasites of fishes of Laurel Creek, Ontario. *Journal of Fish Biology*, 6, 717–728.
<http://dx.doi.org/10.1111/j.1095-8649.1974.tb05114.x>
- Moran, J.D.W., Arthur, J.R. & Burt, M.D.B. (1996) Parasites of sharp-beaked redbishes (*Sebastes fasciatus* and *Sebastes mentella*) collected from the Gulf of St. Lawrence, Canada. *Canadian Journal of Fisheries and Aquatic Sciences*, 53, 1821–1826.
<http://dx.doi.org/10.1139/cjfas-53-8-1821>
- Moravec, F. (1980) Notes on the morphology of *Capillaria catostomi* Pearse, 1924. *Folia Parasitologica*, 27, 381–382.
- Moravec, F. (1987) Revision of capillariid nematodes (subfamily Capillariinae) parasitic in fishes. *Československé Akademie Ved, Studie ČSAV*, 3, 7–141.
- Moravec, F. (2001) *Trichinelloid Nematodes Parasitic in Cold-Blooded Vertebrates*. Academia, Praha, 429 pp.
<http://dx.doi.org/10.14411/fp.2002.007>
- Moravec, F. (2006) *Dracunculoid and Anguillicoloid Nematodes Parasitic in Vertebrates*. Academia, Praha, 634 pp.
<http://dx.doi.org/10.14411/fp.2007.020>
- Moravec, F. (2007) Some aspects of the taxonomy and biology of adult spirurine nematodes parasitic in fishes: a review. *Folia Parasitologica*, 54, 239–257.
<http://dx.doi.org/10.14411/fp.2007.033>
- Moravec, F. (2013) *Parasitic Nematodes of Freshwater Fishes of Europe*. 2nd Edition, Academia, Praha, 601 pp.
- Moravec, F. & Arai, H.P. (1971) The North and Central American species of *Rhabdochona* (Nematoda: Rhabdochonidae) of fishes, including *Rhabdochona canadensis* sp. nov. *Journal of the Fisheries Research Board of Canada*, 28, 1645–1662.
<http://dx.doi.org/10.1139/f71-245>
- Moravec, F., de Buron, I. & Measures, L. (2013) First description of the gravid female of *Philometra rubra* (Leidy, 1856)

- (Nematoda: Philometridae), a parasite of the abdominal cavity of temperate basses *Morone* spp. (Moronidae: Perciformes) in North America. *Journal of Parasitology*, 99, 496–500.
<http://dx.doi.org/10.1645/12-116.1>
- Moravec, F., Conboy, G.A. & Speare, D.J. (2005) A new trichosomoidid from the skin of *Sebastes* spp. (Pisces) from British Columbia, Canada. *Journal of Parasitology*, 91, 411–414.
<http://dx.doi.org/10.1645/ge-3420>
- Moravec, F., Dyková, I. & de Buron, I. (2009a) Female morphology of *Philometra rubra* (Nematoda: Philometridae), a parasite of the abdominal cavity of the striped sea bass *Morone saxatilis* (Moronidae, Perciformes) in the USA. *Folia Parasitologica*, 56, 64–66.
<http://dx.doi.org/10.14411/fp.2009.010>
- Moravec, F., García-Magaña, L. & Salgado-Maldonado, G. (2002) *Spinitectus tabascoensis* sp. nov. (Nematoda, Cystidicolidae) from *Ictalurus furcatus* (Pisces) in southeastern Mexico. *Acta Parasitologica*, 47, 224–227.
- Moravec, F. & Klimpel, S. (2007) New data on the morphology of *Spinitectus oviflagellis* Fourment, 1884 (Nematoda: Cystidicolidae) from the pyloric caeca of *Macrourus berglax* (Macrouridae) in the eastern Greenland Sea. *Systematic Parasitology*, 67, 43–50.
<http://dx.doi.org/10.1007/s11230-006-9069-z>
- Moravec, F., Kohn, A. & Santos, L.A. (1999) New data on *Oncophora melanocephala* (Nematoda: Camallanidae), a little known parasite of scombrid fishes. *Parasite*, 6, 79–84.
<http://dx.doi.org/10.1051/parasite/1999061079>
- Moravec, F., Margolis, L. & Boyce, N.P. (1981) Some nematodes of the genus *Rhabdochona* (Spirurida) from fishes of Japan. *Věstník Československé Společnosti Zoologické*, 45, 277–290.
- Moravec, F., Margolis, L. & McDonald, T.E. (1981) Two new species of nematodes of the genus *Capillaria* (*C. freemani* sp. nov. and *C. parophrysi* sp. nov.) from marine fishes of the Pacific coast of Canada. *Canadian Journal of Zoology*, 59, 81–87.
<http://dx.doi.org/10.1139/z81-013>
- Moravec, F. & McDonald, T.E. (1981) *Capillaria margolisi* sp. nov. (Nematoda: Capillariidae) from a marine fish, *Scorpaenichthys marmoratus* (Ayres), from the west coast of Canada. *Canadian Journal of Zoology*, 59, 88–91.
<http://dx.doi.org/10.1139/z81-014>
- Moravec, F. & Muzzall, P. (2007) Redescription of *Rhabdochona cotti* (Nematoda, Rhabdochonidae) from *Cottus caeruleomentum* (Teleostei, Cottidae) in Maryland, USA, with remarks on the taxonomy of North American *Rhabdochona* spp. *Acta Parasitologica*, 52, 5–57.
<http://dx.doi.org/10.2478/s11686-006-0049-x>
- Moravec, F. & Nagasawa, K. (1999a) New data on the morphology of *Philonema oncorhynchi* Kuitunen-Ekbaum, 1933 (Nematoda: Dracunculoidea) from the abdominal cavity of Pacific salmon (*Oncorhynchus* spp.). *Systematic Parasitology*, 43, 67–74.
<http://dx.doi.org/10.1023/a:1006181528423>
- Moravec, F. & Nagasawa, K. (1999b) Morphology and taxonomy of *Salvelinema* species (Nematoda: Cystidicolidae), swimbladder parasites of Pacific area salmonids. *Folia Parasitologica*, 46, 123–131.
- Moravec, F., Salgado-Maldonado, G., Caspeta-Mandujano, J.M. & González-Solis, D. (2009b) Redescription of *Spinitectus tabascoensis* (Nematoda: Cystidicolidae) from fishes of the Lacandon rain forest in Chiapas, southern Mexico, with remarks on *Spinitectus macrospinosus* and *S. osorioi*. *Folia Parasitologica*, 56, 305–312.
<http://dx.doi.org/10.14411/fp.2009.035>
- Moravec, F., Santos, M.D. & Brasil-Sato, M.C. (2008) Redescription of *Cystidicoloides fischeri* based on specimens from piranhas in Brazil, and erection of a new genus (Nematoda: Cystidicolidae). *Journal of Parasitology*, 94, 889–897.
<http://dx.doi.org/10.1645/ge-1419.1>
- Moravec, F. & Taraschewski, H. (1988) Revision of the genus *Anguillicola* Yamaguti, 1935 (Nematoda: Anguillicolidae) of the swimbladder of eels, including descriptions of two new species, *A. novaezelandiae* sp. n. and *A. papernai* sp. n. *Folia Parasitologica*, 35, 125–146.
- Morrison, C.M., McClelland, G., Cornick, J. & Marcogliese, D. (1986) Parasites and diseases of some marine finfish off Nova Scotia. *Canadian Technical Report of Fisheries and Aquatic Sciences*, No. 1424, 36 pp.
- Moulton, J.M. (1932) A new species of *Haplonema* Ward and Magath, 1916 from the stomach of *Lota maculosa*. *Journal of Parasitology*, 18, 105–107.
<http://dx.doi.org/10.2307/3271970>
- Mudry, D.R. & Anderson, R.S. (1977) Helminth and arthropod parasites of freshwater fishes in Alberta, 1932–1975. *Journal of Fish Biology*, 11, 21–33.
<http://dx.doi.org/10.1111/j.1095-8649.1977.tb04095.x>
- Mudry, D.R. & McCart, P. (1974) *Bulbodacnitis alpinus* sp. nov. (Nematoda: Cucullanidae) from Arctic char, *Salvelinus alpinus* L., with notes on other species of *Bulbodacnitis*. *Canadian Journal of Zoology*, 52, 441–446.
<http://dx.doi.org/10.1139/z74-055>
- Mudry, D.R. & McCart, P. (1976) Metazoan parasites of Arctic char (*Salvelinus alpinus*) from the north slope of Canada and Alaska. *Journal of the Fisheries Research Board of Canada*, 33, 271–275.

<http://dx.doi.org/10.1139/f76-037>

- Mueller, J.F. (1933) On the status of the genus *Dacnitoidea*. *Journal of Parasitology*, 20, 76. [Proceedings of the 152nd Meeting of the Helminthological Society of Washington.]
- Mueller, J.F. (1934) Parasites of Oneida Lake fishes. Part IV. Additional studies on parasites of Oneida Lake fishes including descriptions of new species. *Roosevelt Wild Life Annals*, 3, 335–373.
- Mueller, J.F. & Van Cleave, H.J. (1932) Parasites of Oneida Lake fishes. Part II. Descriptions of new species and some general taxonomic considerations, especially concerning the trematode family Heterophyidae. *Roosevelt Wild Life Annals*, 3, 73–154.
- Munroe, E.G. (1949) Notes on fish of the interior of the Labrador peninsula. *Arctic*, 2, 165–173.
<http://dx.doi.org/10.14430/arctic3986>
- Myers, B.J. (1959a) Parasites of elasmobranch hosts from the Magdalen Islands region of the Gulf of St. Lawrence. *Canadian Journal of Zoology*, 37, 245–246.
<http://dx.doi.org/10.1139/z59-029>
- Myers, B.J. (1959b) *Phocanema*, a new genus for the anisakid nematode of seals. *Canadian Journal of Zoology*, 37, 459–465.
<http://dx.doi.org/10.1139/z59-053>
- Myers, B.J. (1960) On the morphology and life history of *Phocanema decipiens* (Krabbe, 1878) Myers, 1959 (Nematoda: Anisakidae). *Canadian Journal of Zoology*, 38, 331–344.
<http://dx.doi.org/10.1139/z60-038>
- Myers, B.J. (1963) The migration of *Anisakis*-type larvae in experimental animals. *Canadian Journal of Zoology*, 41, 147–148.
<http://dx.doi.org/10.1139/z63-015>
- Myers, R.A. & Brattey, J. (1990) Statistical models for the age-specific and length-specific aggregation of *Pseudoterranova decipiens* (Nematoda: Ascaridoidea) in Atlantic cod, *Gadus morhua*. In: Bowen, W.D. (Ed.). Population Biology of Sealworm (*Pseudoterranova decipiens*) in Relation to its Intermediate and Seal Hosts. *Canadian Bulletin of Fisheries and Aquatic Sciences*, No. 222, pp. 289–301.
- Nadler, S.A., D'Amelio, S., Dailey, M.D., Paggi, L., Siu, S. & Sakanari, J.A. (2005) Molecular phylogenetics and diagnosis of *Anisakis*, *Pseudoterranova*, and *Contracaecum* from northern Pacific marine mammals. *Journal of Parasitology*, 91, 1413–1429.
<http://dx.doi.org/10.1645/ge-522r.1>
- Nadler, S.A. & Hudspeeth, D.S.S. (2000) Phylogeny of the Ascaridoidea (Nematoda: Ascaridida) based on three genes and morphology: hypotheses of structural and sequence evolution. *Journal of Parasitology*, 86, 380–393.
<http://dx.doi.org/10.2307/3284785>
- Naem, S., Pagan, C. & Nadler, S.A. (2010) Structural restoration of nematodes and acanthocephalans fixed in high percentage alcohol using DESS solution and rehydration. *Journal of Parasitology*, 96, 809–811.
<http://dx.doi.org/10.1645/ge-2402.1>
- Neave, F. & Bajkov, A. (1929) Reports of the Jasper Park lakes investigations, 1925–1926. V. Food and growth of Jasper Park fishes. *Contributions to Canadian Biology and Fisheries, New Series*, 4, 197–219.
<http://dx.doi.org/10.1139/f29-016>
- Needler, A.W.H. (1947) Appendix 1. Report for 1946 of the Atlantic Biological Station, St Andrews, N. B. In: J. R. Diamond. *Annual Report of the Fisheries Research Board of Canada for the year 1946*, p. 24–27.
- Nelson, J.S. & Paetz, M.J. (1992) *The Fishes of Alberta*. University of Alberta Press and University of Calgary Press, Edmonton and Calgary, Alberta. 437 pp.
<http://dx.doi.org/10.1002/hep.1840100226>
- Nener, J., Kieser, D., Thompson, J.A.J., Lockhart, W.L., Metner, D.A. & Roome, R. (1995) Monitoring of mountain whitefish *Prosopium williamsoni* from the Columbia River system near Castlegar, British Columbia: health parameters and contaminants in 1992. *Canadian Technical Report of Fisheries and Aquatic Sciences*, No. 2036: xi + 89 pp.
- Nigrelli, R.F. (1938) Parasites of the swordfish, *Xiphias gladius* Linne. *American Museum Novitates* No. 996, 16 pp.
- Noble, E. R. (1973) Parasites and fishes in the deep-sea environment. *Advances in Marine Biology*, 11, 121–195.
[http://dx.doi.org/10.1016/s0065-2881\(08\)60269-2](http://dx.doi.org/10.1016/s0065-2881(08)60269-2)
- Nyman, O.L. & Pippy, J.H.C. (1972) Differences in Atlantic salmon, *Salmo salar*, from North America and Europe. *Journal of the Fisheries Research Board of Canada*, 29, 179–185.
<http://dx.doi.org/10.1139/f72-029>
- Olsen, Y.H. & Merriman, D. (1946) Studies on the marine resources of southern New England. IV. The biology and economic importance of the ocean pout, *Macrozoarces americanus* (Bloch and Schneider). *Bulletin of the Bingham Oceanographic Collection*, 9, 1–184.
- Packer, L., Grixti, J. C., Roughley, R. E. & Hanner, R. (2009) The status of taxonomy in Canada and the impact of DNA barcoding. *Canadian Journal of Zoology*, 87, 1097–1110.
<http://dx.doi.org/10.1139/z09-100>
- Paetz, M.J. & Nelson, J. S. (1970) *The Fishes of Alberta*. Government of Alberta, Queen's Printer, Edmonton, Alberta, 281 pp.
- Page, L.M., Espinosa-Pérez, H., Findley, L.T., Gilbert, C.R., Lea, R.N., Mandrak, N.E., Mayden, R.L. & Nelson, J.S. (2013) *Common and Scientific Names of Fishes from the United States, Canada and Mexico*. 7th Edition. American Fisheries

Society Special Publication No. 34, 384 pp.

- Paggi, L., Mattiucci, S., D'Amelio, S. & Nascetti, G. (1998a) Nematodi del genere *Anisakis* in pesci, cefalopodi e cetacei del Mar Mediterraneo e dell'Oceano Atlantico e Pacifico. *Biologia Marina Mediterranea*, 5, 1585–1592.
- Paggi, L., Mattiucci, S., Gibson, D.I., Berland, B., Nascetti, G., Cianchi, R. & Bullini, L. (2000) *Pseudoterranova decipiens* species A and B (Nematoda: Ascaridoidea): nomenclatural designation, morphological diagnostic characters and genetic markers. *Systematic Parasitology*, 45, 185–197.
<http://dx.doi.org/10.1023/a:1006296316222>
- Paggi, L., Mattiucci, S., Ishikura, H., Kikuchi, K., Nascetti, G., Cianchi, R. & Bullini, L. (1998b) Molecular genetics in anisakid nematodes from the Pacific Boreal Region. In: H. Ishikura, M. Aikawa, H. Itakura & K. Kikuchi (Eds.) *Host Response to International Parasitic Zoonoses*. Springer-Verlag, Tokyo, pp. 83–107 (total 122 pp.)
http://dx.doi.org/10.1007/978-4-431-68281-3_8
- Paggi, L., Nascetti, G., Cianchi, R., Orecchia, P., Mattiucci, S., D'Amelio, S., Berland, B., Bratney, J., Smith, J. W. & Bullini, L. (1991) Genetic evidence for three species within *Pseudoterranova decipiens* (Nematoda, Ascaridida, Ascaridoidea) in the North Atlantic and Norwegian and Barents Seas. *International Journal for Parasitology*, 21, 195–212.
[http://dx.doi.org/10.1016/0020-7519\(91\)90010-5](http://dx.doi.org/10.1016/0020-7519(91)90010-5)
- Palm, H.W. (2011) Fish parasites as biological indicators in a changing world: can we monitor environmental impact and climate change? In: Mehlhorn, H. (Ed.), *Progress in Parasitology, Parasitology Research Monographs*, 2, 223–250.
http://dx.doi.org/10.1007/978-3-642-21396-0_12
- Pálsson, J. (1986) Quantitative studies on the helminth fauna of capelin (*Mallotus villosus* (Müller)) in the northwest Atlantic for purposes of stock determination. *Canadian Technical Report of Fisheries and Aquatic Sciences*, No. 1499, v + 21 pp.
- Pálsson, J. & Beverley-Burton, M. (1984) Helminth parasites of capelin, *Mallotus villosus* (Pisces: Osmeridae) of the North Atlantic. *Proceedings of the Helminthological Society of Washington*, 51, 248–254.
- Parsons, L.S. (1968) Herring studies initiated in 1968. In: Templeman, W. *Fisheries Research Board of Canada, Biological Station, St. John's, Newfoundland. Annual Report and Investigators' Summaries*, p. 15.
- Parsons, L.S. (1969) Herring parasites. In: Templeman, W., *Fisheries Research Board of Canada, Biological Station, St. John's, Newfoundland. Annual Report and Investigators' Summaries*, p. 18.
- Parsons, L.S. (1970) Larval *Anisakis* as indicators of herring stock heterogeneity. In: Templeman, W., *Fisheries Research Board of Canada, Biological Station, St. John's, Newfoundland. Annual Report and Investigators' Summaries*, p. 21.
- Parsons, L.S. (1971) Herring parasites – stock identification. In: Templeman, W. (Ed.), *Fisheries Research Board of Canada, Biological Station, St. John's, Newfoundland. Annual Report and Investigators' Summaries*, p. 20.
- Parsons, L.S. (1972) Herring parasites. In: Fleming, A.M. (Ed.), *Canada Department of Fisheries and Marine Service. Biological Station, St. John's, Newfoundland. Annual Report and Investigators' Summaries*, p. 14.
- Parsons, L.S. & Hodder, V.M. (1971a) Variation in the incidence of larval nematodes in herring from Canadian Atlantic waters. *International Commission for Northwest Atlantic Fisheries, Research Document*, 71/6, 21 pp.
- Parsons, L.S. & Hodder, V.M. (1971b) Variation in the incidence of larval nematodes in herring from Canadian Atlantic waters. *International Commission for Northwest Atlantic Fisheries Research Bulletin*, No. 8, 5–14.
- Parsons, L.S. & Hodder, V.M. (1974) Some biological characteristics of the Fortune Bay, Newfoundland herring stock, 1966–71. *International Commission for Northwest Atlantic Fisheries Research Bulletin*, No. 10, 15–22.
- Pérez-Ponce de León, G. & Nadler, S.A. (2010) What we don't recognise can hurt us: a plea for awareness about cryptic species. *Journal of Parasitology*, 96, 453–464.
<http://dx.doi.org/10.1645/ge-2260.1>
- Petter, A.J. (1975) Deux nouvelles espèces de nématodes Camallanina parasites de *Hoplerythrinus unitaeniatus* (Charcidae, Cypriniformes) en Guyane; création d'une nouvelle famille: les Guyanemidae (Dracunculoidea). *Bulletin du Muséum National d'Histoire*, 3rd series, No. 232, Zoologie 156, 803–812.
- Petter, A.J. (1979) Essai de classification de la sous-famille des Camallaninae (Nematoda, Camallanidae). *Bulletin du Muséum National d'Histoire*, Paris, 4th series 1, section A, No. 4, 991–1008.
- Petter, A.J. & Quentin, J.-C. (1976) Keys to the Genera of the Oxyuroidea. In: Anderson, R. C., Chabaud, A. G. & Willmott, S. (Eds.) *CIH Keys to the Nematode Parasites of Vertebrates*. No. 4, 30 pp. Commonwealth Agricultural Bureaux, Farnham Royal, Bucks, England.
- Pigeon, J. & Vallée, A. (1937) Contribution à l'étude du contenu du tube digestif de trois espèces de poissons du St-Laurent. *Le Naturaliste Canadien (Québec)*, 54, 33–40.
- Pinto, R.M., Vicente, J.J., Noronha, D. & De Fabio, S.P. (1988) Redescription of *Oncophora melanocephala* (Rudolphi, 1819) Baudin-Laurencin, 1971 (Nematoda, Camallanidae). *Memorias do Instituto Oswaldo Cruz*, Rio de Janeiro, 83, 233–237.
<http://dx.doi.org/10.1590/s0074-02761988000200015>
- Pippy, J.H.C. (1965) Studies on the parasites of freshwater fishes (Salmonidae and Coregonidae) of insular Newfoundland. M.Sc. Thesis. Memorial University of Newfoundland, St John's, Newfoundland, 170 pp.
<http://dx.doi.org/10.1139/f67-158>
- Pippy, J.H.C. (1967) Preliminary studies on the use of parasites of Atlantic salmon as a means of distinguishing between eastern and western Atlantic salmon stocks. *International Commission for Northwest Atlantic Fisheries, Research Document*, 67/96, 27 pp.
- Pippy, J.H.C. (1969) Preliminary report on parasites as biological tags in Atlantic salmon (*Salmo salar*). I. Investigations 1966

- to 1968. *Fisheries Research Board of Canada Technical Report*, No. 134, 60 pp.
- Pippy, J.H.C. (1970) Use of ultraviolet light to find parasitic nematodes in situ. *Journal of the Fisheries Research Board of Canada*, 27, 963–965.
<http://dx.doi.org/10.1139/f70-107>
- Pippy, J.H.C. (1972) No. 4. Atlantic salmon parasites – stock identification. In: A. M. Fleming. Canadian Department of Fisheries, Marine Service, Fisheries Research Board of Canada, Newfoundland Biological Station, St. John's, Newfoundland. Annual Report and Investigators' Summaries 1972, 28 pp.
- Pippy, J.H.C. (1973a) No. 2. Studies on larvae of the parasitic nematode *Anisakis* sp. In: A. M. Fleming. Canadian Department of Fisheries, Marine Service, Fisheries Research Board of Canada, Newfoundland Biological Station, St. John's, Newfoundland. Annual Report and Investigators' Summaries 1973, 28 pp.
- Pippy, J.H.C. (1973b) No. 3. The use of Atlantic salmon parasites in stock identification. In: A. M. May. Canadian Department of Fisheries, Marine Service, Fisheries Research Board of Canada, Biological Station, St. John's, Newfoundland. Annual Report and Investigators' Summaries 1973, 28 pp.
- Pippy, J.H.C. (1980) The value of parasites as biological tags in Atlantic salmon at West Greenland. *Rapports et Procès-Verbaux des Réunions. Conseil International pour l'Exploration de la Mer*, 176, 76–81.
- Platzer, E.G. (1964) The life history of *Philonema oncorhynchi* in sockeye salmon from Cultus Lake and the morphometric variation of the adult nematodes. M. Sc. Thesis, University of British Columbia, Vancouver, BC, 91 pp.
- Platzer, E.G. (1966) The life cycle of *Philonema oncorhynchi* (Dracunculoidea) from anadromous hosts. *Proceedings of the 1st International Congress of Parasitology, 21–26 September 1964, Rome, Italy*, p. 561.
<http://dx.doi.org/10.1016/b978-1-4832-2913-3.50449-4>
- Platzer, E., G. & Adams, J.R. (1967) The life history of a dracunculoid, *Philonema oncorhynchi*, in *Oncorhynchus nerka*. *Canadian Journal of Zoology*, 45, 31–43.
<http://dx.doi.org/10.1139/z67-004>
- Poole, B.C. 1983. Fish-parasite population dynamics in small boreal lakes of central Canada. M. Sc. Thesis. Department of Zoology, University of Manitoba, Winnipeg, Manitoba.
- Poole, B.C. & Dick, T.A. (1984) Liver pathology of yellow perch, *Perca flavescens* (Mitchill), infected with larvae of the nematode *Raphidascaris acus* (Bloch, 1779). *Journal of Wildlife Diseases*, 20, 303–307.
<http://dx.doi.org/10.7589/0090-3558-20.4.303>
- Poole, B.C. & Dick, T.A. (1985) Parasite recruitment by stocked walleye, *Stizostedion vitreum vitreum* (Mitchill), fry in a small boreal lake in central Canada. *Journal of Wildlife Diseases*, 21, 371–376.
<http://dx.doi.org/10.7589/0090-3558-21.4.371>
- Poole, B.C. & Dick, T.A. (1986) *Raphidascaris acus* (Bloch, 1779) in northern pike, *Esox lucius* L., walleye, *Stizostedion vitreum vitreum* (Mitchill), and yellow perch, *Perca flavescens* (Mitchill), from central Canada. *Journal of Wildlife Diseases*, 22, 436–436.
<http://dx.doi.org/10.7589/0090-3558-22.3.435>
- Postolaki, A.I. (1962) Biology of the Labrador and Newfoundland cod. In: Marti, Yu. Yu. [sic] (Ed.) *Soviet Fisheries Investigations in the Northwest Atlantic*. Vsesoyuznogo Nauchno-Issledovatel'skii Morskogo Rybnogo Khozyaistva i Okeanografii (VNIRO), 370 pp. (Translated from Russian by the Israel Program for Scientific Translations, Jerusalem. 1963.)
- Poulin, R. & Leung, T.L.F. (2010) Taxonomic resolution in parasite community studies: are things getting worse? *Parasitology*, 137, 1967–1973.
<http://dx.doi.org/10.1017/s0031182010000910>
- Power, G. (1969) The salmon of Ungava Bay. Arctic Institute of North America. Technical Paper No. 22, 72 pp.
<http://dx.doi.org/10.1002/iroh.19710560417>
- Power, H.E. (1958) The effect of various lighting conditions on the efficiency of 'candling' cod fillets for detection of parasites. *Journal of the Fisheries Research Board of Canada*, 15, 537–542.
<http://dx.doi.org/10.1139/f58-026>
- Power, H.E. (1961) Slicing of fillets as an aid to detection and removal of codworms from Atlantic cod fillets. *Journal of the Fisheries Research Board of Canada*, 18, 137–140.
<http://dx.doi.org/10.1139/f61-010>
- Priebe, K. (1986) Muskelparasiten des Alaska-Pollocks *Theragra chalcogramma*. *Archiv für Lebensmittelhygiene*, 37, 149–152.
- Pritchard, A.L. (1931) Taxonomic and life history studies of the ciscoes of Lake Ontario. *University of Toronto Studies in Biology*, 35, 1–78. (Ontario Fisheries Research Laboratory Publication, No. 41)
- Pritchard, M.H. & Kruse, G.O.W. (1982) *The Collection and Preservation of Animal Parasites*. Lincoln and London, University of Nebraska Press, ii + 141 pp.
<http://dx.doi.org/10.1007/bf00010984>
- Pufall, E.L., Jones-Bitton, A., McEwen, S.A., Brown, T.M., Edge, V.L., Rokicki, J., Karpiej, K., Peregrine, A.S. & Simard, M. (2012) Prevalence of zoonotic anisakid nematodes in Inuit-harvested fish and mammals from the Eastern Canadian Arctic. *Foodborne Pathogens and Disease*, 9, 1002–1009.
<http://dx.doi.org/10.1089/fpd.2012.1186>

- Pybus, M.J., Anderson, R.C. & Uhazy, L.S. (1978a) Redescription of *Truttaedacnitis stelmooides* (Vessichelli, 1910) (Nematoda: Cucullanidae) from *Lampetra lamottenii* (LeSueur, 1827). *Proceedings of the Helminthological Society of Washington*, 45, 238–245.
<http://dx.doi.org/10.1139/z78-195>
- Pybus, M.J. & Samuel, W.M. (1978) Summary of field trips – Wildlife Parasitology class, University of Alberta. Department of Zoology, University of Alberta, Edmonton, Alberta. Unpublished Report.
- Pybus, M.J., Uhazy, L.S. & Anderson, R.C. (1978b) Life cycle of *Truttaedacnitis stelmooides* (Vessichelli, 1910) (Nematoda: Cucullanidae) in American brook lamprey (*Lampetra lamottenii*). *Canadian Journal of Zoology*, 56, 1420–1429.
<http://dx.doi.org/10.1139/z78-195>
- Radkau, J. (2014) *The Age of Ecology. A Global History*. Polity Press, Cambridge, UK, xiii + 546 pp. [Translated from the 2011 original German]
- Rafi, F. (1988) Isopoda, pp. 129–148. In: L. Margolis & Z. Kabata (Eds.). Guide to the Parasites of Fishes of Canada. Part II—Crustacea. *Canadian Special Publication of Fisheries and Aquatic Sciences*, 107, 184 pp.
<http://dx.doi.org/10.1163/193724088x00567>
- Rahman, H. (1964) On the morphology of the hitherto undescribed male of *Spinitectus oviflagellis* Fourment, 1884 (Nematoda: Rhabdochonidae). *Parasitology*, 54, 695–698.
<http://dx.doi.org/10.1017/s0031182000082718>
- Ramakrishna, N.R. & Burt, M.D.B. (1990) The tissue response of rainbow trout (*Oncorhynchus mykiss*) and Atlantic cod (*Gadus morhua*) to infection of *Pseudoterranova decipiens* (Krabbe, 1878) (Nematoda: Ascaridoidea [sic]). Program and Abstracts. 29th Annual Meeting, Canadian Society of Zoologists, Simon Fraser University, 02–05 May 1990. *Bulletin of the Canadian Society of Zoologists*, 21, 82.
- Ramakrishna, N.R. & Burt, M.D.B. (1991) Tissue response of fish to invasion by larval *Pseudoterranova decipiens* (Nematoda; Ascaridoidea). *Canadian Journal of Fisheries and Aquatic Sciences*, 48, 1623–1628.
<http://dx.doi.org/10.1139/f91-192>
- Ramakrishna, N.R., Burt, M.D.B. & MacKinnon, B.M. (1993) Cell-mediated immune response of rainbow trout (*Oncorhynchus mykiss*) to larval *Pseudoterranova decipiens* (Nematoda; Ascaridoidea) following sensitization to live sealworm, sealworm extract, and nonhomologous extracts. *Canadian Journal of Fisheries and Aquatic Sciences*, 50, 60–65.
<http://dx.doi.org/10.1139/f93-007>
- Rasheed, S. (1963) A revision of the genus *Philometra* Costa, 1845. *Journal of Helminthology*, 37, 89–130.
<http://dx.doi.org/10.1017/s0022149x00019672>
- Rawson, D.S. (1939) A biological survey and recommendations for fisheries management in the waters of Banff National Park. National and Historic Parks Bureau, Manuscript Report, University of Saskatchewan, 128 pp.
- Rawson, D.S. (1951) Studies of the fish of Great Slave Lake. *Journal of the Fisheries Research Board of Canada*, 8, 207–240.
<http://dx.doi.org/10.1139/f50-014>
- Rawson, D.S. (1959) Limnology and fisheries of Cree and Wollaston lakes in northern Saskatchewan. *Saskatchewan Department of Natural Resources, Fisheries Branch Report*, No. 4: 73 pp.
- Rawson, D.S. (1961) The lake trout of Lac la Ronge, Saskatchewan. *Journal of the Fisheries Research Board of Canada*, 18, 423–462.
<http://dx.doi.org/10.1139/f61-038>
- Redkozubova, O.I. (1976) [Parasitological situation in the region of southern Labrador and northern Newfoundland Bank.] In: Kratiek Tezisy Dokladov II Vsesoyuznogo Simpoziuma po Parazitam I Bolezniam Morskikh Zhivotnykh, p. 5354. [Proceedings of the 2nd All-Union Symposium on the parasites and diseases of marine animals. Abstracts.] Ministerstvo Rybnogo Khozyaistva SSSR. AtlantNIRO, Kaliningrad USSR, 84 pp. (In Russian.)
- Redkozubova, O.I. (1978) [The parasite fauna of pleuronectids from the Atlantic coast of Canada.] In: I Vsesoyuznyi s'ezd Parazitotsenologov (Poltava, Sentyabr' 1978). Tezisy Dokladov, Chast'3, p. 133–134. [1st All-Union Meeting of Parasitocoenologists (Poltava, September 1978). Abstracts. Part 3.] "Naukova Dumka", Kiev, USSR, 191 pp. (In Russian.)
- Reed, E.B. (1962) Limnology and fisheries of the Saskatchewan River in Saskatchewan. Saskatchewan Department of Natural Resources, Fisheries Report, No. 6, 48 pp.
- Reed, G.B. (1953) Atlantic Biological Station, St Andrews, New Brunswick In: G. B. Reed. Annual Report of the Fisheries Research Board of Canada—1952, pp. 21–48.
- Reid, H. (1930) A study of *Eupomotis gibbosus* (L.) as occurring in Chamcook Lakes, New Brunswick. *Contributions to Canadian Biology and Fisheries*, 5, 457–466.
<http://dx.doi.org/10.1139/f30-016>
- Reimchen, T.E. (1997) Parasitism of asymmetrical pelvic phenotypes in sticklebacks. *Canadian Journal of Zoology*, 75, 2984–2994.
<http://dx.doi.org/10.1139/z97-843>
- Reimchen, T.E. & Nosil, P. (2001) Ecological causes of sex-biased parasitism in threespine stickleback. *Biological Journal of the Linnean Society*, 73, 51–63.
<http://dx.doi.org/10.1111/j.1095-8312.2001.tb01346.x>

- Reimer, L.W. (1981) Parasiten aus *Reinhardtius hippoglossoides* (Walbaum), dem schwarzen Heilbutt aus dem Nord-Atlantik. In: Wissenschaftliche Konferenz zu Fragen der Physiologie, Biologie und Parasitologie von Nutzfischen: p. 121–123. Vol 3, bis 6, September 1980 in Rostock, 183 pp.
- Richardson, L.R. (1935) A record of *Octomitis salmonis* Moore from Quebec. *Transactions of the American Fisheries Society*, 65, 290–292.
[http://dx.doi.org/10.1577/1548-8659\(1935\)65\[290:aroosm\]2.0.co;2](http://dx.doi.org/10.1577/1548-8659(1935)65[290:aroosm]2.0.co;2)
- Richardson, L.R. (1936a) Notes on the parasites of *Salvelinus fontinalis* (Mitchill) in Lake Edward (Quebec) with a description of *Philonema salvelini* sp. n. (Filarioidea) and a description of *Echinocephalus lateralis* Leidy, 1851. Minutes of the Proceedings of the Royal Society of Canada (Appendix B), p. 109. (Abstract Report – read 22 May.)
- Richardson, L.R. (1936b) Observations on the parasites of the speckled trout in Lake Edward, Quebec. *Transactions of the American Fisheries Society*, 66, 343–356.
[http://dx.doi.org/10.1577/1548-8659\(1936\)66\[343:ootpot\]2.0.co;2](http://dx.doi.org/10.1577/1548-8659(1936)66[343:ootpot]2.0.co;2)
- Richardson, L.R. (1937) *Raphidascaris laurentianus* sp. n. (Ascaroidea [sic]) from *Salvelinus fontinalis* (Mitchill) in Quebec. *Canadian Journal of Research, Section D*, 15, 112–115.
<http://dx.doi.org/10.1139/cjr37d-010>
- Richardson, L.R. (1942) The parasites of fishes of Lake Wakonichi, central northern Quebec. *Transactions of the American Fisheries Society*, 71, 286–289.
[http://dx.doi.org/10.1577/1548-8659\(1941\)71\[286:tpotfo\]2.0.co;2](http://dx.doi.org/10.1577/1548-8659(1941)71[286:tpotfo]2.0.co;2)
- Ricker, W.E. (1932) Studies of speckled trout (*Salvelinus fontinalis*) in Ontario. *University of Toronto Studies in Biology*, 36, 69–110. (Ontario Fisheries Research Laboratory Publication, No. 44.)
<http://dx.doi.org/10.2307/1446323>
- Robinson, D.G., Barraclough, W.E. & Fulton, J.D. (1968) Data record. Number, size composition, weight and food of larval and juvenile fish caught with a two-boat trawl in the Strait of Georgia June 5–9, 1967. *Fisheries Research Board of Canada Manuscript Report*, Serial No. 972, 109 pp.
- Rockwell, L.S., Jones, K.M.M. & Cone, D.K. (2009) First record of *Anguillicoloides crassus* (Nematoda) in American eels (*Anguilla rostrata*) in Canadian estuaries, Cape Breton, Nova Scotia. *Journal of Parasitology*, 95, 483–486.
<http://dx.doi.org/10.1645/ge-1739.1>
- Ronald, K. (1956) A possible test for nematode viability. *Canadian Journal of Zoology*, 34, 76–77.
<http://dx.doi.org/10.1139/z56-012>
- Ronald, K. (1960) The effects of physical stimuli on the larval stage of *Terranova decipiens* (Krabbe, 1878) (Nematoda: Anisakidae). I. Temperature. *Canadian Journal of Zoology*, 38, 623–642.
<http://dx.doi.org/10.1139/z60-066>
- Ronald, K. (1962) The effects of physical stimuli on the larvae of *Terranova decipiens*. II. Relative humidity, pressure and gases. *Canadian Journal of Zoology*, 40, 1223–1227.
<http://dx.doi.org/10.1139/z62-097>
- Ronald, K. (1963) The metazoan parasites of the Heterosomata of the Gulf of St. Lawrence. VII. Nematoda and Acanthocephala. *Canadian Journal of Zoology*, 41, 15–21.
<http://dx.doi.org/10.1139/z63-002>
- Roth, M. (1988) Morphology and development of the egg case in the parasitic copepod *Haemobaphes intermedius* Kabata, 1967 (Copepoda: Pennellidae). *Canadian Journal of Zoology*, 66, 2573–2577.
<http://dx.doi.org/10.1139/z88-378>
- Russell, L.R. (1980) Effects of *Truttaedacnitis truttae* (Nematoda: Cucullanidae) on the growth and swimming of rainbow trout, *Salmo gairdneri*. *Canadian Journal of Zoology*, 58, 1220–1226.
<http://dx.doi.org/10.1139/z80-171>
- Rye, L.A. & Baker, M.R. (1984) *Hysterothylacium analarum* n. sp. (Nematoda: Anisakidae) from pumpkinseed, *Lepomis gibbosus* (Linnaeus), in southern Ontario. *Canadian Journal of Zoology*, 62, 2307–2312.
<http://dx.doi.org/10.1139/z84-337>
- Rye, L.A. & Baker, M.R. (1987) The biology of *Hysterothylacium analarum* (Nematoda: Ascaridoidea) in *Lepomis gibbosus* from Dawson Pond near Dorset, Ontario. Program and Abstracts. 26th Annual Meeting, Canadian Society of Zoologists, McGill University, 13–15 May 1987. *Bulletin of the Canadian Society of Zoologists*, 18, 22.
- Rye, L.A. & Baker, M.R. (1992) The life history of *Hysterothylacium analarum* Rye and Baker, 1984 (Nematoda: Anisakidae) in *Lepomis gibbosus* (Pisces: Centrarchidae) in southern Ontario, Canada. *Canadian Journal of Zoology*, 70, 1576–1584.
<http://dx.doi.org/10.1139/z92-217>
- Samuel, W.M. (1981) Parasites of fish from William A. Switzer Provincial Park, 1975–1981. Unpublished Report. Department of Zoology, University of Alberta, Edmonton, Alberta, 9 pp.
- Samuel, W.M. (1985) Parasites of fish from William A. Switzer Provincial Park, 1975–1985 with specific emphasis on results of the February 1985 collection. Unpublished Report. Department of Zoology, University of Alberta, Edmonton, Alberta, 12 pp.
- Sandeman, I.M. & Pippy, J.H.C. (1967) Parasites of freshwater fishes (Salmonidae and Coregonidae) of insular Newfoundland. *Journal of the Fisheries Research Board of Canada*, 24, 1911–1943.
<http://dx.doi.org/10.1139/f67-158>

- Sankurathri, C.S., Kabata, Z. & Whitaker, D.J. (1983) Parasites of the Pacific hake, *Merluccius productus* (Ayres, 1855) in the Strait of Georgia, in 1974–1975. *Syesis*, 16, 5–22.
- Schlick-Steiner, B.C., Steiner, F.M., Seifert, B., Stauffer, C., Christian, E. & Crozier, R.H. (2010) Integrative taxonomy: a multisource approach to exploring biodiversity. *Annual Review of Entomology*, 55, 421–438.
<http://dx.doi.org/10.1146/annurev-ento-112408-085432>
- Scholz, T. & Choudhury, A. (2014) Parasites of freshwater fishes in North America: why so neglected? *Journal of Parasitology*, 100, 26–45.
<http://dx.doi.org/10.1645/13-394.1>
- Scott, D.M. (1950) Note no. 112: A preliminary report on the cod-worm investigation. *Fisheries Research Board of Canada Progress Reports of the Atlantic Coast Stations*, No. 48, 10–12.
- Scott, D.M. (1953) Experiments with the harbour seal, *Phoca vitulina*, a definitive host of a marine nematode, *Porrocaecum decipiens*. *Journal of the Fisheries Research Board of Canada*, 10, 539–547.
<http://dx.doi.org/10.1139/f53-031>
- Scott, D.M. (1954) Experimental infection of Atlantic cod with a larval marine nematode from smelt. *Journal of the Fisheries Research Board of Canada*, 11, 894–900.
<http://dx.doi.org/10.1139/f54-050>
- Scott, D.M. (1956) On the specific identity of the larval *Porrocaecum* (Nematoda) in Atlantic cod. *Journal of the Fisheries Research Board of Canada*, 13, 343–356.
<http://dx.doi.org/10.1139/f56-023>
- Scott, D.M. & Black, W.F. (1960) Studies on the life-history of the ascarid *Porrocaecum decipiens* in the Bras d'Or lakes, Nova Scotia. *Journal of the Fisheries Research Board of Canada*, 17, 763–774.
<http://dx.doi.org/10.1139/f60-064>
- Scott, D.M. & Fisher, H.D. (1958) Incidence of the ascarid *Porrocaecum decipiens* in the stomachs of three species of seals along the southern Canadian Atlantic mainland. *Journal of the Fisheries Research Board of Canada*, 15, 495–516.
<http://dx.doi.org/10.1139/f58-023>
- Scott, D.M. & Martin, W. R. (1957) Variation in the incidence of larval nematodes in Atlantic cod fillets along the southern Canadian mainland. *Journal of the Fisheries Research Board of Canada*, 14, 975–996.
<http://dx.doi.org/10.1139/f57-043>
- Scott, D.M. & Martin, W.R. (1959) The incidence of nematodes in fillets of small cod from Lockeport, Nova Scotia, and the southwestern Gulf of St. Lawrence. *Journal of the Fisheries Research Board of Canada*, 16, 213–221.
<http://dx.doi.org/10.1139/f59-017>
- Scott, J.S. (1973) Intestinal helminth parasites of northern sand lance (*Ammodytes dubius*). *Journal of the Fisheries Research Board of Canada*, 30, 291–292.
<http://dx.doi.org/10.1139/f73-050>
- Scott, J.S. (1981) Alimentary tract parasites of haddock (*Melanogrammus aeglefinus* L.) on the Scotian Shelf. *Canadian Journal of Zoology*, 59, 2244–2252.
<http://dx.doi.org/10.1139/z81-304>
- Scott, J.S. (1982) Erratum: Alimentary tract parasites of haddock (*Melanogrammus aeglefinus* L.) on the Scotian Shelf. *Canadian Journal of Zoology*, 60, 1779.
<http://dx.doi.org/10.1139/z82-230>
- Scott, J.S. (1985) Occurrence of alimentary tract parasites of pollock (*Pollachius virens* L.) on the Scotian Shelf. *Canadian Journal of Zoology*, 63, 1695–1698.
<http://dx.doi.org/10.1139/z85-252>
- Scott, J.S. (1987) Helminth parasites of the alimentary tracts of hakes (*Merluccius*, *Urophycis*, *Phycis*: Teleostei) of the Scotian Shelf. *Canadian Journal of Zoology*, 6, 304–311.
<http://dx.doi.org/10.1139/z87-047>
- Scott, J.S. (1988) Helminth parasites of redfish (*Sebastes fasciatus*) from the Scotian Shelf, Bay of Fundy and eastern Gulf of Maine. *Canadian Journal of Zoology*, 66, 617–621.
<http://dx.doi.org/10.1139/z88-092>
- Scott, J.S. & Bray, S.A. (1989) Helminths of the alimentary tract of Atlantic halibut (*Hippoglossus hippoglossus* L.) and Greenland halibut (*Reinhardtius hippoglossoides* (Walbaum)) on the Scotian Shelf. *Canadian Journal of Zoology*, 67, 1467–1481.
<http://dx.doi.org/10.1139/z89-209>
- Scott, W.B. & Scott, M.G. (1988) Atlantic Fishes of Canada. *Canadian Bulletin of Fisheries and Aquatic Sciences*, No. 210, 731 pp.
- Séguin, G., Bouchard, F., Measures, L.N., Uhland, C.F. & Lair, S. (2011) Infections with *Philometra* sp. associated with mortalities in wild-hatched captive-raised striped bass, *Morone saxatilis* (Walbaum). *Journal of Fish Diseases*, 34, 475–481.
<http://dx.doi.org/10.1111/j.1365-2761.2011.01258.x>
- Sekerak, A.D. & Arai, H.P. (1973) Helminths of *Sebastes alutus* (Pisces: Teleostei) from the northeastern Pacific. *Canadian Journal of Zoology*, 51, 475–477.

<http://dx.doi.org/10.1139/z73-071>

- Sekerak, A.D. & Arai, H.P. (1977) Some metazoan parasites of rockfishes of the genus *Sebastes* from the northeastern Pacific Ocean. *Syesis*, 10, 139–144.
- Sekhar S., C. [sic] & Threlfall, W. (1970) Helminth parasites of the cunner, *Tautogolabrus adspersus* (Walbaum) in Newfoundland. *Journal of Helminthology*, 44, 169–188.
<http://dx.doi.org/10.1017/s0022149x00021726>
- Shih, H.-H. (2004) Parasitic helminth fauna of the cutlass fish, *Trichiurus lepturus* L. and the differentiation of four anisakid nematode third-stage larvae by nuclear ribosomal DNA sequences. *Parasitology Research*, 93, 188–195.
<http://dx.doi.org/10.1007/s00436-004-1095-7>
- Shostak, A.W. & Dick, T.A. (1986) Intestinal pathology in northern pike, *Esox lucius* L., infected with *Trienophorus crassus* Forel, 1868 (Cestoda: Pseudophyllidea). *Journal of Fish Diseases*, 9, 35–45.
<http://dx.doi.org/10.1111/j.1365-2761.1986.tb00977.x>
- Shostak, A.W. & Dick, T.A. (1989) Helminth position within the intestine of naturally infected pike (*Esox lucius*) relative to host stomach contents. *Journal of Parasitology*, 75, 905–910.
<http://dx.doi.org/10.2307/3282869>
- Simon, J.R. & Simon, F. (1936) *Philonema agubernaculum* sp. nov. (Dracunculidae), a nematode from the body cavity of fishes. *Parasitology*, 28, 440–442.
<http://dx.doi.org/10.1017/s0031182000022617>
- Sindermann, C.J. (1957) Diseases of fishes of the western North Atlantic. V. Parasites as indicators of herring movements. *Maine Department of Sea and Shore Fisheries Research Bulletin*, 27, 30 pp.
- Sindermann, C.J. (1959a) Population studies of herring using parasitological and serological methods. Fisheries Investigations, International Passamaquoddy Fisheries Board, Report to the International Joint Commission. Appendix III (Biology – United States), 16 pp.
- Sindermann, C.J. (1959b) Zoogeography of sea herring parasites. *Program and Abstracts. 34th Annual Meeting, American Society of Parasitologists, University Park, Pa., 30 Aug.–02 Sept. 1959. Journal of Parasitology*, 45 (4, Sect. 2), 34.
- Sindermann, C.J. (1961a) Parasite tags for marine fish. *Journal of Wildlife Management*, 25, 41–47.
<http://dx.doi.org/10.2307/3796989>
- Sindermann, C.J. (1961b) Parasitological tags for redfish of the western North Atlantic. *Rapports et Procès-Verbaux des Réunions. Conseil International pour l'Exploration de la Mer*, 150, 111–117.
- Skinker, M.S. (1930) “A new species of nematode of the genus *Cystidicola* from fishes.” [NB: there is no formal title]. *Proceedings. 121st Meeting, Helminthological Society of Washington, 18 May 1929, Washington, D. C. Journal of Parasitology*, 16, 167.
- Skinker, M.S. (1931) Three new parasitic nematode worms. *Proceedings of the United States National Museum*, 79 (Art. 24), 1–9.
<http://dx.doi.org/10.5479/si.00963801.79-2890.1>
- Šlapeta, J. (2013) Ten simple rules for describing a new (parasite) species. *International Journal for Parasitology: Parasites and Wildlife*, 2, 152–154.
<http://dx.doi.org/10.1016/j.ijppaw.2013.03.005>
- Smedley, E.M. (1933) Nematode parasites from Canadian marine and freshwater fishes. *Contributions to Canadian Biology and Fisheries*, 8, 169–179.
<http://dx.doi.org/10.1139/f33-014>
- Smedley, E.M. (1934) Some parasitic nematodes from Canadian fishes. *Journal of Helminthology*, 12, 205–220.
<http://dx.doi.org/10.1017/s0022149x00004260>
- Smith, H.D. (1973) Observations on the cestode *Eubothrium salvelini* in juvenile sockeye salmon (*Oncorhynchus nerka*) at Babine Lake, British Columbia. *Journal of the Fisheries Research Board of Canada*, 30, 947–964.
<http://dx.doi.org/10.1139/f74-220>
- Smith, J.D. (1984a) Taxonomy of *Raphidascaris* spp. (Nematoda: Anisakidae) of fishes, with a redescription of *R. acus* (Bloch, 1772). *Canadian Journal of Zoology*, 62, 685–694.
<http://dx.doi.org/10.1139/z84-100>
- Smith, J.D. (1984b) Development of *Raphidascaris acus* (Nematoda: Anisakidae) in paratenic, intermediate and definitive hosts. *Canadian Journal of Zoology*, 62, 1378–1386.
<http://dx.doi.org/10.1139/z84-198>
- Smith, J.D. (1986) Seasonal transmission of *Raphidascaris acus* (Nematoda), a parasite of freshwater fishes, in definitive and intermediate hosts. *Environmental Biology of Fishes*, 16, 295–308.
<http://dx.doi.org/10.1007/bf00842985>
- Smith, J.D. & Anderson, R.C. (1981) Seasonality of *Raphidascaris canadensis* (Nematoda: Anisakidae) in the intermediate host, yellow perch (*Perca flavescens*). *Program and Abstracts. 20th Annual Meeting, Canadian Society of Zoologists, University of Waterloo, 10–13 May 1981. Bulletin of the Canadian Society of Zoologists*, 12, 86.
- Smith, J.D. & Anderson, R.C. (1982) Seasonality of *Raphidascaris acus* (Nematoda) in intermediate and definitive hosts. *Abstracts. 5th International Congress of Parasitology, 07–14 August 1982, Toronto, Canada. Molecular and Biochemical Parasitology. Supplement (Parasites – Their World and Ours)*, pp. 352–353.

- Smith, J.D. & Lankester, M.W. (1979) Development of the swim bladder nematodes (*Cystidicola* spp.) in their intermediate hosts. *Canadian Journal of Zoology*, 57, 1736–1744.
<http://dx.doi.org/10.1139/z79-225>
- Smith, J.W. (1983) *Anisakis simplex* (Rudolphi, 1809, det. Krabbe, 1878) (Nematoda: Ascaridoidea): morphology and morphometry of larvae from euphausiids and fish, and a review of the life-history and ecology. *Journal of Helminthology*, 57, 205–224.
<http://dx.doi.org/10.1017/s0022149x00009512>
- Smith, J.W. (1999) Ascaridoid nematodes and pathology of the alimentary tract and its associated organs in vertebrates, including man: a literature review. *Helminthological Abstracts*, 68, 49–96.
- Smith, J.W., Elarifi, A.E., Wootten, R., Pike, A.W. & Burt, M.D.B. (1990) Experimental infection of rainbow trout, *Oncorhynchus mykiss*, with *Contracaecum osculatum* (Rudolphi, 1802) and *Pseudoterranova decipiens* (Krabbe, 1878) (Nematoda: Ascaridoidea). *Canadian Journal of Fisheries and Aquatic Sciences*, 47, 2293–2296.
<http://dx.doi.org/10.1139/f90-255>
- Smith, J.W. & Wootten, R. (1975) Experimental studies on the migration of *Anisakis* sp. larvae (Nematoda: Ascaridida) into the flesh of herring, *Clupea harengus* L. *International Journal for Parasitology*, 5, 133–136.
[http://dx.doi.org/10.1016/0020-7519\(75\)90019-3](http://dx.doi.org/10.1016/0020-7519(75)90019-3)
- Smith, J.W. & Wootten, R. (1978) *Anisakis* and anisakiasis. *Advances in Parasitology*, 16, 93–163.
[http://dx.doi.org/10.1016/s0065-308x\(08\)60573-4](http://dx.doi.org/10.1016/s0065-308x(08)60573-4)
- Smith, J.W. & Wootten, R. (1984a) *Pseudoterranova* larvae ('codworm') (Nematoda) in fish. Fiche 7. In: Fiches d'Identification des Maladies et Parasites des Poissons, Crustacés et Mollusques. Sindermann, C. J. (Ed.). Conseil International pour l'Exploration de la Mer, Copenhagen.
- Smith, J.W. & Wootten, R. (1984b) *Anisakis* larvae ('herringworm') (Nematoda). Fiche 8. In: Fiches d'Identification des Maladies et Parasites des Poissons, Crustacés et Mollusques. Sindermann, C. J. (Ed.). Conseil International pour l'Exploration de la Mer, Copenhagen.
- Smith, J.W. & Wootten, R. (1984c) *Phocascaris* / *Contracaecum* larvae (Nematoda) in fish. Fiche 9. In: Fiches d'Identification des Maladies, et Parasites des Poissons, Crustacés et Mollusques. Sindermann, C.J. (Ed.). Conseil International pour l'Exploration de la Mer, Copenhagen.
- Spencer Jones, M.E. & Gibson, D.I. (1987) A list of old and recently erected genus-group names not included in the 'CIH Keys' to nematode parasites of vertebrates and invertebrates. *Systematic Parasitology*, 9, 125–136.
<http://dx.doi.org/10.1007/bf00012190>
- Stanley, R.D., Lee, D.L. & Whitaker, D.J. (1992) Parasites of yellowtail rockfish, *Sebastes flavidus* (Ayres, 1862) (Pisces:Teleostei) from the Pacific coast of North America as potential biological tags for stock identification. *Canadian Journal of Zoology*, 70, 1086–1096.
<http://dx.doi.org/10.1139/z92-152>
- Stewart, D.B. & Bernier, L.M.J. (1982) An aquatic resource survey of islands bordering Viscount Melville Sound, District of Franklin, Northwest Territories. Environment Canada and Department of Indian and Northern Affairs, Northern Environmental Protection Branch, Land Directorate. *Northern Land Use Series, Background Report*, No. 2, 110 pp.
- Stewart, D.B. & Bernier, L.M.J. (1983) An aquatic resource survey of Victoria and King William islands and the northeastern District of Keewatin, Northwest Territories. Environment Canada and Department of Indian and Northern Affairs, Northern Environmental Protection Branch, Land Directorate. *Northern Land Use Series, Background Report*, No. 3, 127 pp.
- Stewart, D.B. & Bernier, L.M.J. (1984) An aquatic resource survey of Melville Peninsula, Southampton Island, and the northeastern District of Keewatin, Northwest Territories. Environment Canada and Department of Indian and Northern Affairs, Northern Environmental Protection Branch, Land Directorate. *Northern Land Use Series, Background Report*, No. 4, 144 pp.
- Stewart, D.B. & MacDonald, G. (1978) Arctic Land Use Research Program 1977: a survey of the fisheries of the central Northwest Territories. *Department of Indian and Northern Affairs, Environmental Study*, No. 8, 121 pp.
- Stewart-Hay, R.K. (1951a) A biological survey of Snow Lake, Manitoba. *Manitoba Department of Mines and Natural Resources, Game and Fisheries Branch Report*, 20 pp.
- Stewart-Hay, R.K. (1951b) A biological survey of Lake Dauphin–Summer 1951. *Manitoba Department of Mines and Natural Resources, Game and Fisheries Branch Report*, 44 pp.
- Stewart-Hay, R.K. (1951c) A biological survey of Wellman Lake–Summer 1951. *Manitoba Department of Mines and Natural Resources, Game and Fisheries Branch Report*, 20 pp.
- Stewart-Hay, R.K. (1952a) A limited biological survey of Burton Lake–August 1952. *Manitoba Department of Mines and Natural Resources, Game and Fisheries Branch Report*, 8 pp.
- Stewart-Hay, R.K. (1952b) An investigation of certain waters of the Porcupine Mountains–Summer 1952. *Manitoba Department of Mines and Natural Resources, Game and Fisheries Branch Report*, 114 pp.
- Stewart-Hay, R.K. (1953a) A biological survey of Lake Athapapaskow–July 1953. *Manitoba Department of Mines and Natural Resources, Game and Fisheries Branch Report*, 79 pp.
- Stewart-Hay, R.K. (1953b) A brief biological survey of Second Cranberry Lake– August 1953. *Manitoba Department of Mines and Natural Resources, Game and Fisheries Branch Report*, 19 pp.

- Stewart-Hay, R.K. (1953c) A biological survey of three unnamed lakes in Whiteshell Forest Reserve–August 1953. *Manitoba Department of Mines and Natural Resources, Game and Fisheries Branch Report*, 17 pp.
- Stock, T.M. (1988) Helminth parasites of lake whitefish, *Coregonus clupeaformis*, and northern pike, *Esox lucius*, from Jarvis Lake, Alberta. Unpublished Report. Department of Zoology, University of Alberta, Edmonton, Alberta, 12 pp.
- Stromberg, P.C. & Crites, J.L. (1974) The life cycle and development of *Camallanus oxycephalus* Ward and Magath, 1916. *Journal of Parasitology*, 60, 117–124.
<http://dx.doi.org/10.2307/3278688>
- Stromberg, P.C., Shegog, J.H. & Crites, J.L. (1973) A description of the male and redescription of the female of *Camallanus oxycephalus* Ward and Magath, 1916 (Nematoda: Camallanidae). *Proceedings of the Helminthological Society of Washington*, 40, 234–237.
<http://dx.doi.org/10.2307/3278688>
- Swanson, G.M., Kansas, K.R., Matkowski, S.M. & Graveline, P. (1991) A report on the fisheries resources of the lower Nelson River and the impact of hydroelectric development, 1989 data. *Manitoba Department of Natural Resources. Fisheries Branch, Manuscript Report 91–03*, 248 pp.
- Szalai, A.J. (1989) Factors affecting community structure, transmission and regulation of fish-parasites in Dauphin Lake, Manitoba. Ph. D. Dissertation. Department of Zoology, University of Manitoba, Winnipeg, Manitoba, 309 pp.
- Szalai, A.J., Craig, J.F. & Dick, T.A. (1992a) Parasites of fishes from Dauphin Lake, Manitoba, 1985–1987. *Canadian Technical Report of Fisheries and Aquatic Sciences*, No. 1735, 36 pp.
- Szalai, A.J. & Dick, T.A. (1988) Differences in numbers and reproductive variability during the egg-producing period for *Raphidascaris acus*. *Program and Abstracts. 63rd Annual Meeting, American Society of Parasitologists, 31 July–04 August, 1988*. Winston-Salem, North Carolina, p. 36.
- Szalai, A.J. & Dick, T.A. (1989) Differences in numbers and inequalities in mass and fecundity during the egg-producing period for *Raphidascaris acus* (Nematoda: Anisakidae). *Parasitology*, 98, 489–495.
<http://dx.doi.org/10.1017/s0031182000061588>
- Szalai, A.J. & Dick, T.A. (1990) *Proteocephalus ambloplitis* and *Contracaecum* sp. from largemouth bass (*Micropterus salmoides*) stocked in Boundary Reservoir, Saskatchewan. *Journal of Parasitology*, 76, 598–601.
<http://dx.doi.org/10.2307/3282854>
- Szalai, A.J. & Dick, T.A. (1991) Role of predation and parasitism in growth and mortality of yellow perch in Dauphin Lake, Manitoba. *Transactions of the American Fisheries Society*, 120, 739–751.
[http://dx.doi.org/10.1577/1548-8659\(1991\)120<0739:ropapi>2.3.co;2](http://dx.doi.org/10.1577/1548-8659(1991)120<0739:ropapi>2.3.co;2)
- Szalai, A.J., Lysack, W. & Dick, T.A. (1992b) Use of confidence ellipses to detect effects of parasites on the growth of yellow perch, *Perca flavescens*. *Journal of Parasitology*, 78, 64–69.
<http://dx.doi.org/10.2307/3283688>
- Szuks, H. (1980) Die Verenbarkeit von Parasiten zur Gruppen trennung beim Grenadierfisch *Macrourus rupestris*. *Angewandte Parasitologie*, 21, 211–214.
- Tedla, S. (1969) The ecology of some metazoan parasites of the yellow perch, *Perca flavescens* L. Ph. D. Dissertation. Department of Biology, University of Waterloo, Waterloo, Ontario, 208 pp.
- Tedla, S. & Fernando, C.H. (1969a) Observations on the seasonal changes of the parasite fauna of yellow perch (*Perca flavescens*) from the Bay of Quinte, Lake Ontario. *Journal of the Fisheries Research Board of Canada*, 26, 833–843.
<http://dx.doi.org/10.1139/f69-081>
- Tedla, S. & Fernando, C.H. (1969b) Changes in the parasite fauna of the white perch, *Roccus americanus* (Gmelin), colonizing new habitats. *Journal of Parasitology*, 55, 1063–1066.
<http://dx.doi.org/10.2307/3277175>
- Tedla, S. & Fernando, C.H. (1972) On the characterization of the parasite fauna of yellow perch (*Perca flavescens* L.) in five lakes in southern Ontario. *Helminthologia (Bratislava)*, 11, 23–33.
- Templeman, W. (1948) The life history of the capelin (*Mallotus villosus* (O. F. Müller)) in Newfoundland waters. *Bulletin of the Newfoundland Government Laboratory 17 (Research)*, 1–151.
- Templeman, W. (1967) Atlantic salmon from the Labrador Sea and off West Greenland, taken during the A. T. Cameron cruise, July–August 1965. *International Commission for North Atlantic Fisheries Research Bulletin*, 4, 5–40.
- Templeman, W. (1968) Review of some aspects of capelin biology in the Canadian area of the northwest Atlantic. *Rapports et Procès-Verbaux des Réunions. Conseil International pour l'Exploration de la Mer*, 158, 41–53.
- Templeman, W., Squires, H.J. & Fleming, A.M. (1957) Nematodes in the fillets of cod and other fishes in Newfoundland and neighbouring areas. *Journal of the Fisheries Research Board of Canada*, 14, 831–897.
<http://dx.doi.org/10.1139/f57-037>
- Thompson, P.A. & Threlfall, W. (1978) The metazoan parasites of two species of fish from the Port-Cartier-Sept-Iles Park, Quebec. *Le Naturaliste Canadien (Québec)*, 105, 429–431.
- Thomson, J.A.C. (1957) On the biology of the Arctic char, *Salvelinus alpinus* (L.) of Nettilling Lake, Baffin Island, N.W.T. M. Sc. Thesis. Department of Biology, McGill University, Montreal, Québec, 95 pp.
- Threlfall, W. (1969) Some parasites from elasmobranchs in Newfoundland. *Journal of the Fisheries Research Board of Canada*, 26, 805–811.
<http://dx.doi.org/10.1139/f69-078>

- Threlfall, W. (1981) Metazoan parasites of two populations of rainbow smelt in Newfoundland, Canada. *Journal of Parasitology*, 67, 129–131.
<http://dx.doi.org/10.2307/3280798>
- Threlfall, W. (1982) In vitro culture of *Anisakis* spp. larvae from fish and squid in Newfoundland, Canada. *Proceedings of the Helminthological Society of Washington*, 49, 65–70.
- Threlfall, W. & Hanek, G. (1969) *Capillaria salvelini* Polyansky, 1952 from *Salvelinus fontinalis* (Mitchill). *Canadian Journal of Zoology*, 47, 1088–1090.
<http://dx.doi.org/10.1139/z69-171>
- Threlfall, W. & Hanek, G. (1970a) Metazoan parasites, excluding Monogenea, from longnose and white suckers. *Journal of the Fisheries Research Board of Canada*, 27, 1317–1319.
<http://dx.doi.org/10.1139/f70-153>
- Threlfall, W. & Hanek, G. (1970b) Helminths from northern pike (*Esox lucius* L.) in Labrador. *Journal of Parasitology*, 56, 662.
<http://dx.doi.org/10.2307/3277710>
- Threlfall, W. & Hanek, G. (1970c) Metazoan parasites of salmonids and coregonids from the Avalon Peninsula, Newfoundland. *Journal of the Fisheries Research Board of Canada*, 27, 1894–1897.
<http://dx.doi.org/10.1139/f70-213>
- Threlfall, W. & Hanek, G. (1971) Helminth parasites, excluding Monogenea, from some Labrador fishes. *Journal of Parasitology*, 57, 684–685.
<http://dx.doi.org/10.2307/3277945>
- Tibbo, S.N., Day, L.R. & Doucet, W.F. (1961) The swordfish (*Xiphias gladius* L.), its life history and economic significance in the northwest Atlantic. *Fisheries Research Board of Canada Bulletin*, No. 130, 47 pp.
- Townsley, P.M., Wight, H.G., Scott, M.A. & Hughes, M. (1963) The in-vitro maturation of the parasitic nematode, *Terranova decipiens*, from cod muscle. *Journal of the Fisheries Research Board of Canada*, 20, 743–747.
<http://dx.doi.org/10.1139/f63-049>
- Uhazy, L.S. (1976) *Philometroides huronensis* n. sp. (Nematoda: Dracunculoidea) of the common white sucker (*Catostomus commersoni*) from Lake Huron, Ontario. *Canadian Journal of Zoology*, 54, 369–376.
<http://dx.doi.org/10.1139/z76-041>
- Uhazy, L.S. (1977a) Development of *Philometroides huronensis* (Nematoda: Dracunculoidea) in the intermediate and definitive hosts. *Canadian Journal of Zoology*, 55, 265–273.
<http://dx.doi.org/10.1139/z77-035>
- Uhazy, L.S. (1977b) Biology of *Philometroides huronensis* (Nematoda: Dracunculoidea) in the white sucker (*Catostomus commersoni*). *Canadian Journal of Zoology*, 55, 1430–1441.
<http://dx.doi.org/10.1139/z77-186>
- Uhazy, L.S. (1977c) Biology of *Philometroides huronensis* n. sp. (Nematoda: Dracunculoidea) of common white sucker (*Catostomus commersoni*). *Dissertation Abstracts International*. 37B (9), 4361–4362.
<http://dx.doi.org/10.1139/z76-041>
- Uhazy, L.S. (1978) Lesions associated with *Philometroides huronensis* (Nematoda: Philometridae) in the white sucker (*Catostomus commersoni*). *Journal of Wildlife Diseases*, 14, 401–408.
<http://dx.doi.org/10.7589/0090-3558-14.4.401>
- Uhazy, L.S. & Anderson, R.C. (1976) Biology of *Philometroides huronensis* (Nematoda: Dracunculoidea) in the white sucker (*Catostomus commersoni*). *Program and Abstracts. 51st Annual Meeting, American Society of Parasitologists, November 1975*, New Orleans, Louisiana, Abstract 102, p. 47.
- Urawa, S., Nagasawa, K., Margolis, L. & Moles, A. (1998) Stock identification of chinook salmon (*Oncorhynchus tshawytscha*) in the North Pacific Ocean and Bering Sea by parasite tags. *North Pacific Anadromous Fish Commission Bulletin*, No. 1, 199–204.
- Van Cleave, H.J. & Mueller, J.F. (1932) Parasites of Oneida Lake fishes. Part I. Descriptions of new genera and new species. *Roosevelt Wild Life Annals*, 3 (1), 1–72.
- Van Cleave, H.J. & Mueller, J.F. (1934) Parasites of Oneida Lake fishes. Part III. A biological and ecological survey of the worm parasites. *Roosevelt Wild Life Annals*, 3 (3), 161–334.
- Van Thiel, P.H., Kuipers, F.C. & Roskam, T.H. (1960) A nematode parasitic to herring, causing acute abdominal syndromes in man. *Tropical and Geographical Medicine*, 12, 97–113.
- Vaughan, D.B. & Christison, K.W. (2010) A new species of *Myxinidocotyle* (Monogenea: Acanthocotylidae: Myxinidocotylinae) from captive sixgill hagfish, *Eptatretus hexatrema* (Chordata: Myxinidae), with amendment of the subfamily diagnosis. *Zootaxa*, 2650, 47–56.
- Vaughan, S., Sadler, M., Jayakumar, S., Missaghi, B., Chan, W. & Church, D.L. (2015) An unusual case of abdominal pain. *Canadian Journal of Infectious Diseases and Medical Microbiology*, 26, 297–298.
- Walder, G.L. & Arai, H.P. (1974) The helminth parasites of embiotocid fishes. III. A new species of the genus *Cucullanellus* Tornquist, 1931 (Nematoda: Cucullanidae) from the shiner perch, *Cymatogaster aggregata* Gibbons. *Journal of the Fisheries Research Board of Canada*, 31, 205–209.
- Waldron, D.E. (1992) Diet of the silver hake (*Merluccius bilinearis*) on the Scotian Shelf. *Journal of Northwest Atlantic Fisheries Science*, 14, 87–101.

<http://dx.doi.org/10.2960/j.v14.a6>

- Walton, A.C. (1928) A revision of the nematodes of the Leidy collection. *Proceedings of the Academy of Natural Sciences, Philadelphia*, 79, 49–143.
- Ward, H.B. & Magath, T.B. (1916) Notes on some nematodes from fresh-water fishes. *Journal of Parasitology*, 3, 57–64.
<http://dx.doi.org/10.2307/3271002>
- Watson, R.A. (1977) Metazoan parasites from whitefish, cisco, and pike from Southern Indian Lake, Manitoba. A pre-impoundment and diversion analysis. M. Sc. Thesis. Department of Zoology, University of Manitoba, Winnipeg, Manitoba, 197 pp.
- Watson, R.A. & Dick, T.A. (1979) Metazoan parasites of whitefish, *Coregonus clupeaformis* (Mitchill) and *C. artedi* LeSueur from Southern Indian Lake, Manitoba. *Journal of Fish Biology*, 15, 579–587.
<http://dx.doi.org/10.1111/j.1095-8649.1979.tb03648.x>
- Watson, R.A. & Dick, T.A. (1980) Metazoan parasites of pike, *Esox lucius* Linnaeus, from Southern Indian Lake, Manitoba. *Journal of Fish Biology*, 17, 255–261.
<http://dx.doi.org/10.1111/j.1095-8649.1980.tb02759.x>
- Wells, B., Steele, D.H. & Tyler, A.V. (1973) Intertidal feeding of winter flounders (*Pleuronectes americanus*) in the Bay of Fundy. *Journal of the Fisheries Research Board of Canada*, 30, 1374–1378.
<http://dx.doi.org/10.1139/f73-221>
- Wells, R., Pippy, J.H.C. & Bishop, C.A. (1985) Nematodes in cod collected from NAFO Division 2J, 3K, 3L, 3Ps in Autumn, 1983. *Canadian Atlantic Fisheries, Science Advisory Committee, Research Document* 85/79, 14 pp.
- Wharton, D.A. (2003) The environmental physiology of Antarctic terrestrial nematodes: a review. *Journal of Comparative Physiology B: Biochemistry, Systematics, and Environmental Physiology*, 173, 621–628.
<http://dx.doi.org/10.1007/s00360-003-0378-0>
- Wheaton, R.R. & Hazen, G.E.M. (1951) Whitefish-*Triaenophorus crassus* investigations on Nesslin Lake, Saskatchewan, 1950. *Fisheries Research Board of Canada Manuscript Report (Biology)*, No. 494, 15 pp.
- Whitaker, D.J. (1985) A parasite survey of juvenile chum salmon (*Oncorhynchus keta*) from the Nanaimo River. *Canadian Journal of Zoology*, 63, 2875–2877.
<http://dx.doi.org/10.1139/z85-428>
- White, F.M. (1940) Studies on the morphology of a new species of *Cystidicola* (Nematoda: Thelaziidae) from the swim bladder of the lake trout. Program and Abstracts, 16th Annual Meeting, American Society of Parasitologists, 30–31 December 1940, 01 January 1941, Philadelphia, Pennsylvania. *Journal of Parasitology*, 26 (Supplement), 39–40.
- White, F.M. (1941) Studies on the morphology of *Cystidicola cristivomeri* sp. nov. (Nematoda: Thelaziidae) from the swim bladder of the lake trout. *Proceedings of the Indiana Academy of Science*, 50, 211.
<http://dx.doi.org/10.2307/2420824>
- White, F.M. & Cable, R.M. (1942) Studies on the morphology of *Cystidicola cristivomeri* sp. nov. (Nematoda: Thelaziidae) from the swim bladder of the lake trout, *Cristivomer namaycush* (Walbaum). *American Midland Naturalist*, 28, 416–423.
<http://dx.doi.org/10.2307/2420824>
- Wierzbicka, J. (1988) Parasite fauna of the blue halibut (*Reinhardtius hippoglossoides* Walbaum, 1792) from selected districts of its distribution area. *Akademia Rolnicza, Szczecin, Poland*. 87 pp. (Translated from Polish by *Canadian Translation of Fisheries and Aquatic Sciences*, No. 5520, 115 pp.)
- Wierzbicka, J. (1991a) Parasite fauna of the Greenland halibut *Reinhardtius hippoglossoides* (Walbaum) from Labrador area. *Acta Ichthyologica et Piscatoria*, 21, 21–29.
- Wierzbicka, J. (1991b) An analysis of the parasitic fauna of Greenland halibut, *Reinhardtius hippoglossoides* (Walbaum, 1792), in different age groups. *Acta Ichthyologica et Piscatoria*, 21, 31–41.
<http://dx.doi.org/10.3750/AIP1991.21.1.02>
- Wierzbicka, J. & Piasecki, W. (1998) Parasite fauna of *Atheresthes stomias* (Jordan et Gilbert, 1880) (Pleuronectiformes) from the northeastern Pacific Ocean. *Acta Ichthyologica et Piscatoria*, 28, 49–57.
<http://dx.doi.org/10.3750/AIP1998.28.1.06>
- Wijová, M., Moravec, F., Horák, A. & Lukeš, J. (2006) Evolutionary relationships of Spirurina (Nematoda: Chromadorea: Rhabditida) with special emphasis on dracunculoid nematodes inferred from SSU rRNA gene sequences. *International Journal for Parasitology*, 36, 1067–1075.
<http://dx.doi.org/10.1016/j.ijpara.2006.04.005>
- Wiles, M. (1968) Possible effects of the harbour seal bounty on codworm infections of Atlantic cod in the Gulf of St. Lawrence, the Strait of Belle Isle, and the Labrador Sea. *Journal of the Fisheries Research Board of Canada*, 25, 2749–2753.
<http://dx.doi.org/10.1139/f68-254>
- Wiles, M. (1975) Parasites of *Fundulus diaphanus* (Le Sueur) (Pisces: Cyprinodontidae) in certain Nova Scotian freshwaters. *Canadian Journal of Zoology*, 53, 1578–1580.
<http://dx.doi.org/10.1139/z75-192>
- Willmott, S. (1974) Glossary of Terms. In: Anderson, R.C., Chabaud, A.G. & Willmott, S. (Eds.). *CIH Keys to the Nematode Parasites of Vertebrates*. No. 1, pp. 1–5. Commonwealth Agricultural Bureaux, Farnham Royal, Bucks, England.
- Wilson, K.A. (1967) Parasite fauna of the sea lamprey (*Petromyzon marinus* von Linne) in the Great Lakes region. M. Sc.

- Thesis. Department of Zoology, University of Guelph, Guelph, Ontario, 127 pp.
<http://dx.doi.org/10.1139/z67-118>
- Wilson, K.A. & Ronald, K. (1967) Parasite fauna of the sea lamprey (*Petromyzon marinus* von Linne) in the Great Lakes region. *Canadian Journal of Zoology*, 45, 1083–1092.
<http://dx.doi.org/10.1139/z67-118>
- Winters, G.H. (1970) Biological changes in coastal capelin from the over-wintering to spawning condition. *Journal of the Fisheries Research Board of Canada*, 27, 2215–2224.
<http://dx.doi.org/10.1139/f70-250>
- Winters, G.H. & Campbell, J.S. (1974) Some biological aspects and population parameters of Grand Bank capelin. *International Commission for Northwest Atlantic Fisheries, Research Documents*, Serial No. 3309, 23 pp.
- Wong, P.L. & Anderson, R.C. (1982) The transmission and development of *Cosmocephalus obvelatus* (Nematoda: Acuarioidea) of gulls (Laridae). *Canadian Journal of Zoology*, 60, 1426–1440.
<http://dx.doi.org/10.1139/z82-192>
- Wong, P.L. & Anderson, R.C. (1987) Development of *Syncuaria squamata* (Linstow, 1883) (Nematoda: Acuarioidea) in ostracods (Ostracoda) and double-breasted cormorants (*Phalacrocorax auritus auritus*). *Canadian Journal of Zoology*, 65, 2524–2531.
<http://dx.doi.org/10.1139/z87-381>
- Wood, C.C., Riddell, B. E., Rutherford, D. T. & Rutherford, K. I. (1987) Variation in biological characters among sockeye salmon populations in the Stikine River with potential application for stock identification in mixed-stock fisheries. *Canadian Technical Report on Fisheries and Aquatic Sciences*, No. 1535, 61 pp.
- Wood, J.W. (1965) A report on fish disease as a possible cause of pre-spawning mortalities of Fraser River sockeye. International Pacific Salmon Fisheries Commission, New Westminster, British Columbia, 24 pp.
- Worley, D.E. & Bangham, R.V. (1952) Some parasites of fishes of the upper Gatineau River valley. *Ohio Journal of Science*, 52, 210–212.
- Wright, R.R. (1879) Contributions to American helminthology. *Proceedings of the Canadian Institute, New Series*, 1, 54–57.
- Yamaguti, S. (1935) Studies on the helminth fauna of Japan. Part 9. Nematodes of fishes, I. *Japanese Journal of Zoology*, 6, 337–386.
<http://dx.doi.org/10.1017/s0022149x00017788>
- Yamaguti, S. (1961) *Systema Helminthum*. Volume III. The Nematodes of Vertebrates. Part I. New York. Interscience Publishers Ltd., London, 1261 pp.
<http://dx.doi.org/10.1126/science.141.3584.897>
- Yanulov, K.P. (1962) Parasites as indicators of local redfish stocks. In: Marti, Yu. Yu. (Ed.). *Soviet Fisheries Investigations in the Northwest Atlantic*. VNIRO and PINRO, Moscow. (Department of the Environment, Fisheries and Marine Service, Biological Station, St. John's, Newfoundland, Translation Series No. 3252 (1974), 15 pp. typescript.)
- Yoshinaga, T., Ogawa, K. & Wakabayashi, H. (1989) Life cycle of *Hysterothylacium haze* (Nematoda: Anisakidae: Raphidascaridinae). *Journal of Parasitology*, 75, 756–763.
<http://dx.doi.org/10.2307/3283061>
- Zelmer, D.A. (1994) Helminths of yellow perch (*Perca flavescens*) from Alberta. M. Sc. Thesis. Department of Biological Sciences, University of Calgary, Calgary, Alberta, 103 pp.
- Zelmer, D.A. & Arai, H. P. (1998) The contributions of host age and size to the aggregated distribution of parasites in yellow perch, *Perca flavescens*, from Garner Lake, Alberta. *Journal of Parasitology*, 84, 24–28.
<http://dx.doi.org/10.2307/3284522>
- Zelmer, D.A. & Arai, H. P. (2004) Development of nestedness: host biology as a community process in parasite infracommunities of yellow perch (*Perca flavescens* (Mitchill)) from Garner Lake, Alberta. *Journal of Parasitology*, 90, 435–436.
<http://dx.doi.org/10.1645/ge-3291rn>
- Zenkin, V.S. & Umnova, V. A. (1976) Parasitological, serological and biochemical studies of herring populations. *Rybnogo Khozyaistva*, No. 3, 13–15. (FMS translation from Russian: Translation Series No. 4441.)
- Zhu, X., D'Amelio, S., Palm, H. W., Paggi, L., George-Nascimento, M. & Gasser, R. B. (2002) SSCP-based identification of members within the *Pseudoterranova decipiens* complex (Nematoda: Ascaridoidea: Anisakidae) using genetic markers in the internal transcribed spacers of ribosomal DNA. *Parasitology*, 124, 616–623.
<http://dx.doi.org/10.1017/s0031182002001579>
- Zubchenko, A.V. (1975) [On the parasite fauna of macrourids in the North Atlantic.] *Trudy Polyarni Nauchno-Issledovatel'skii i Proektnyi Institut Morskogo Rybnogo Khozyaistva i Okeanografii*, 35, 234–238. [In Russian]
- Zubchenko, A.V. (1976) [On the question of the existence of separate populations of the blunt-nosed macrurid (*Macrourus rupestris* Gunner) from the northwest Atlantic in the light of its parasitological data.] In: Gaevskaya, A. V. (Ed.). Summaries of Reports from the Second All-Union Symposium on Parasites and Diseases of Marine Animals. AtlantNIRO, Kaliningrad, pp. 29–30. [In Russian]
- Zubchenko, A.V. (1980) Parasitic fauna of Anarhichadidae and Pleuronectidae families of fish in the northwest Atlantic. *International Commission for Northwest Atlantic Fisheries, Selected Papers*, No. 6, 41–46.
- Zubchenko, A.V. (1981a) Parasitic fauna of some Macrouridae in the northwest Atlantic. *Journal of Northwest Atlantic*

Fisheries Science, 2, 67–72.

<http://dx.doi.org/10.2960/j.v2.a8>

- Zubchenko, A.V. (1981b) [Using parasitological data in studying rock grenadier (*Coryphaenoides rupestris* Gunner) local groupings.] In: Bauer, O.N. (Eds.), *Symposium on Parasitology and Pathology of Marine Organisms*, Leningrad. (Abstract), pp. 25–32. [In Russian: for English version see *NOAA Technical Report*, 25, 19–23]
- Zubchenko, A.V. (1984) [Ecological peculiarities of the parasite fauna of some fishes of the family Alepocephalidae.] In: *Ecologo-parasitological studies of the northern seas*. Murmansk Morskogo Biological Institute, Apatity, pp. 77–81. (In Russian.)
- Zubchenko, A.V. (1985a) Parasite fauna of American plaice (*Hippoglossoides platessoides*) from the northwest Atlantic. *Journal of Northwest Atlantic Fisheries Science*, 6, 165–171.
<http://dx.doi.org/10.2960/j.v6.a17>
- Zubchenko, A.V. (1985b) Use of parasitological data in studies of the local groupings of rock grenadier, *Coryphaenoides rupestris* Gunner. In: Hargis Jr, W. J. (Ed.). *Parasitology and Pathology of Marine Animals of the World Oceans* (pp. 19–23). United States Department of Commerce, NOAA Technical Report National Marine Fisheries Service, No. 25, iv + 135 pp.

INDEX TO NEMATODE PARASITES

- Acuariidae 7, 12, 16, 114–115
Acuariinae 115
Acuarioidea 5, 7, 16, 36, 114
Agamonema sp. *auct.*—see *Nematoda* gen. sp.
Agamospirura sp. *auct.*—see *Nematoda* gen. sp.
Anacanthocheilus—see *Pseudanisakis* 119
Ancyracanthus—see *Cystidicola*
Anguillicola 7, 8, 36–38, 181, 201
Anguillicola crassus 7, 8, 36–38, 181, 201
Anguillicolidae 7, 36–37
Anguillicoloidea 5, 16, 36
Anisakidae 6, 16, 119, 121
*Anisakidae gen. sp. 128, 194, 200–201, 205, 221, 223
Anisakinae 121
*Anisakinae gen. sp. 128, 182, 204–205, 219–222
Anisakinea 121
Anisakis 6–9, 119, 121
**Anisakis simplex* 121–122, 126, 128, 131, 179–182, 188–194, 198–201, 204–206, 208–210, 216–223
**Anisakis* sp. 122–123, 179–182, 189, 191–194, 197–211, 215–223
Ascaridoidea 5, 16, 19
Ascaridomorpha 7, 16, 34, 119
Ascarophis 8, 84
Ascarophis arctica 84–85, 189, 198–201, 210, 216–217, 220, 223
Ascarophis extalicola 86–87, 200, 209
Ascarophis filiformis 86–88, 200, 210, 220, 223
Ascarophis morrhuae 89–90, 182, 200, 203, 217, 219
Ascarophis Sebastodis 90–91, 191–192, 202–210, 217, 222
Ascarophis sp. 90, 189–191, 198–199, 207, 210, 223

Bulbodacnitis—see *Truttaedacnitis*
Bulbodacnitis alpinus—see *Truttaedacnitis truttae*
Bulbodacnitis globosa—see *Truttaedacnitis truttae*
Bulbodacnitis occidentalis—see *Truttaedacnitis truttae*
Bulbodacnitis sphaerocephala—see *Truttaedacnitis sphaerocephala*
Bulbodacnitis truttae—see *Truttaedacnitis truttae*

Caballeronema 8, 84, 92
Caballeronema pseudoargmentosus—see *Capillospirura pseudoargmentosa*
Caballeronema wardlei 92–93
Camallanidae 16, 60, 64
Camallanoidea 5, 16, 36, 60

Camallanus 8, 60
 ***Camallanus ancyloides* 61–62
 ***Camallanus oxycephalus* 62–64, 181, 183–188, 192, 194, 196–197, 200–203, 208, 211–215
Camallanus sp. 64, 180, 197, 214
Capillaria 8, 23
Capillaria bakeri—see *Pseudocapillaria* (*Pseudocapillaria*) *tomentosa*
Capillaria catostomi—see *Pseudocapillaria* (*Pseudocapillaria*) *tomentosa*
Capillaria (*Capillaroides*) *catenata* 23, 26–27, 187, 189, 193, 212
Capillaria freemani—see *Piscicapillaria* (*Piscicapillaria*) *freemani*
Capillaria kabatai—see *Capillaria* (*Procapillaria*) *gracilis*
Capillaria (*Procapillaria*) *gracilis* 23, 25, 198–199, 209, 218, 221
Capillaria parophrysi—see *Paracapillaria* (*Paracapillaria*) *parophrysi*
Capillaria (*Procapillaria*) *margolisi* 23–24, 210, 221
Capillaria salvelini—see *Pseudocapillaria* (*Ichthyocapillaria*) *salvelini*
Capillaria sp. 192–193, 200, 204–209, 211, 213, 216–217, 221–222
Capillaria (*Thominx*) *catenata*—see *Capillaria* (*Capillaroides*) *catenata*
Capillariidae 5–6, 16, 21, 23, 28, 30
Capillariidae gen. sp. 27, 183, 185, 192
Capillospirura 8, 84, 92
Capillospirura pseudoargumentosa 93–94, 180
Chromadorea 16–17, 34
Chromadoria 16
Clavinema 8, 42
Clavinema mariae 43–44, 208, 217–218, 221–222
Comecophoronema—see *Cystidicola*
Contracaecinea 121, 128
 **Contracaecinea* gen. sp. 133, 189, 194, 200, 202–205, 220, 223
Contracaecum 6–9, 121, 128, 134
Contracaecum (*Acollaris*)—see *Hysterothylacium*
Contracaecum (*Erschovicaecum*)—see *Hysterothylacium*
Contracaecum (*Simplexonema*)—see *Hysterothylacium*
Contracaecum (*Thynnascaris*)—see *Hysterothylacium*
Contracaecum aduncum—see *Hysterothylacium aduncum*
Contracaecum brachyurum—see *Hysterothylacium brachyurum*
Contracaecum clavatum—see *Hysterothylacium aduncum*
Contracaecum gadi—see *Hysterothylacium aduncum*
Contracaecum incurvum—see *Hysterothylacium incurvum*
Contracaecum magnum—see *Hysterothylacium magnum*
Contracaecum melanogrammi—see *Hysterothylacium melanogrammi*
 **Contracaecum osculatum* 128–129, 189, 193, 199–201, 209, 220–221, 223
 **Contracaecum rudolphii* 130–131, 202
 **Contracaecum spiculigerum* 130–132, 185, 192, 211, 213
 **Contracaecum* sp. 131, 179–185, 187–200, 202–222
 **Contracaecum* sp. and/or **Phocascaris* sp. 133, 180, 189, 199–201, 209, 211, 220–221, 223
Cosmocephalus 8, 115
 **Cosmocephalus obvelatus* 115–116, 184, 186, 189, 202–203, 210
Cucullanellus 8, 151, 166
Cucullanellus cotylophora 166–168, 188, 197, 200, 211–215
Cucullanellus kanabus 168–170, 215
Cucullanellus minutus 170–171, 216
Cucullanidae 150, 152, 158, 164, 166
Cucullanus 8, 151, 158
Cucullanus annulatus 158–160, 222
Cucullanus cirratus 160–161, 199–201, 221
Cucullanus clitellarius—see *Truttaedacnitis clitellarius*
Cucullanus elongatus 160–163, 204–207
Cucullanus heterochrous 163–164, 220–222
Cucullanus smedleyi—see *Cucullanus elongatus*
Cucullanus sp. 163, 191, 202–206, 213, 215, 221, 223
Cystidicola 8, 10, 84, 95
Cystidicola canadensis—see *Cystidicola farionis*

Cystidicola farionis 95–97, 99, 186, 189–197, 203, 214–215
Cystidicola cristivomeri—see *Cystidicola stigmatura*
Cystidicola lepisostei 97, 180
Cystidicola salmonicola—see *Salvelinema salmonicola*
Cystidicola serratus 97, 190
Cystidicola stigmatura—see also *Cystidicola farionis*
Cystidicola walkeri—see *Salvelinema walkeri*
Cystidicola sp. 99, 190–197, 202
Cystidicolidae 16, 83–84, 92, 95, 100, 103, 106
Cystidicoloides 91, 100
Cystidicoloides ephemeridarum—see *Salmonema ephemeridarum*
Cystidicoloides harwoodi—see *Salmonema ephemeridarum*
Cystidicoloides tenuissima—see *Salmonema ephemeridarum*
Cystoosidae 5, 16, 21
Cystoopsis acipenseris 8, 21–22, 180

Dacnitis—see *Truttaedacnitis*
Dacnitoides cotylophora—see *Cucullanellus cotylophora*
Dacnitoides robusta—see *Dichelyne robustus*
Daniconema 8, 39
Daniconema anguillae 39–40, 181
Daniconematidae 16, 37–39
Dichelyne 8, 151, 164, 166
Dichelyne cotylophora—see *Cucullanellus cotylophora*
Dichelyne robustus 165–166, 188
Dichelyne sp. 166
Diectophyme 8, 18
**Diectophyme renale* 18–19, 188
**Diectophyme* sp. 18
Diectophymatida 15, 17
Diectophymatidae 5, 16–17
Diectophymatina 16–17
Dorylaimia 15, 17
Dracunculoidea 5, 16, 36–37

Enoplea 15, 17
**Eustoma* sp.—see **Pseudanisakis* sp.
Eustrongylides 7–8, 18
**Eustrongylides* sp. 21, 178, 183, 185, 187, 191–196, 200, 203, 208, 212, 214–215
**Eustrongylides tubifex* 19–20, 186–188, 202–203, 211–215, 223

Fissula—see *Cystidicola*

Gnathostomatidae 16, 58
Gnathostomatoidea 5, 16, 36, 58
Gnathostomatomorpha 7, 16
Guyanemidae 16, 37, 39–40

Habronematoidea 5, 16, 36, 83, 114
Haplonema 8, 171
Haplonema aditum—see *Paraquimperia tenerrima*
Haplonema hamulatum 171–173, 192, 194–195, 200
Haplonema immutatum 173–174, 181
Haplonema sp. 173, 200, 208
Hedruridae 16, 83, 114
Hedruris sp. 8, 83, 114
Hepaticola bakeri—see *Pseudocapillaria (Pseudocapillaria) tomentosa*
Huffmanella canadensis 7, 8, 34–35
Huffmanella sp. 207
Hysterothylacium 7, 8, 134–135
***Hysterothylacium aduncum* 139–141, 179, 182, 189, 191–196, 198–202, 204–207, 209, 211, 216–223

***Hysterothylacium analarum* 135–137, 212
***Hysterothylacium brachyurum* 137–138, 181, 184, 187–188, 190, 195–197, 200, 203, 212–215
Hysterothylacium corrugatum 141–142, 219
Hysterothylacium incurvum 143–144, 219
Hysterothylacium magnum 144, 207, 209, 217
Hysterothylacium melanogrammi 144, 200
Hysterothylacium reliquens 145, 219
***Hysterothylacium* sp. 134, 146, 181–182, 185, 187, 189–190, 192–195, 198–203, 207–208, 211–212, 216, 219, 223

Ichthyofilaria 8, 42, 44
Ichthyofilaria canadensis 44–45, 216
Ichthyonema cylindracea—see *Philometra cylindracea*
Iheringascaris—see *Hysterothylacium*
Indocucullanus—see *Cucullanus*

Metabronema canadense—see *Salmonema ephemeridarum*
Metabronema harwoodi—see *Salmonema ephemeridarum*
Metabronema prevosti—see *Salmonema prevosti*
Metabronema salvelini—see *Salmonema ephemeridarum*
**Metabronema* sp. 99–100, 196
Metabronema wardlei—see *Caballeronema wardlei*
Metanisakis—see *Pseudanisakis*
Metastrongyloidea 5, 7, 16, 36, 176

Nematoda 7, 15–17
***Nematoda* gen. sp. 177, 180–198, 200–203, 206–216, 218, 223

Oncophora 8, 60, 64
Oncophora melanocephala 64–66, 219
Ophiostoma—see *Cystidicola*
Oxyuridae 16
Oxyuridomorpha 7, 16, 34, 60
Oxyuroidea 5, 16, 60, 182
Oxyuroidea gen. sp. 60, 182

Paracapillaria 8, 23, 28
Paracapillaria (Paracapillaria) parophrysi 28–30, 221–222
Paracuaria 8, 115
**Paracuaria adunca* 115, 117, 182, 184, 186, 202, 203, 210
Paraquimperia 8, 171, 174
Paraquimperia aditum—see *Paraquimperia tenerrima*
Paraquimperia tenerrima 175–176, 181
Pharurus 8
**Pharurus pallasii* 7, 176–177, 209, 221
Philometra 8, 42, 46
Philometra americana—see *Clavinema mariae*
Philometra cylindracea 46–47, 195, 214–215
Philometra kobuleji 46, 48, 187
Philometra mariae—see *Clavinema mariae*
Philometra nodulosa—see *Philometroides nodulosus*
Philometra rubra 7, 49–50, 212
Philometra sanguinea [*Philometridae* gen. sp.]
***Philometra* sp. 43, 50, 186–187, 189, 190, 193, 195, 197, 202, 212–215, 217, 222
Philometridae 7, 16, 37, 42, 44, 46, 50, 54
Philometridae gen. sp. 58, 218, 221–222
Philometroides 8, 35, 42, 50, 58
Philometroides huronensis 51–52, 186–188
Philometroides nodulosus 52–54, 186–187
**Philometroides* sp. 54, 187
Philonema 8, 54
***Philonema agubernaculum* 54–56, 189–190, 192–196, 203

***Philonema oncorhynchi* 56–57, 191–193, 195
***Philonema salvelini*–see ***Philonema agubernaculum*
***Philonema* sp. 57–58, 182, 187, 190–197
Phocanema decipiens–see **Pseudoterranova decipiens*
Phocanema sp. larva–see **Pseudoterranova* sp.
Phocascaris 8–9, 121, 128, 131, 133–134
**Phocascaris* sp. 128, 133, 189, 200, 209, 211, 216, 221, 223
Piscicapillaria 8, 23, 28
Piscicapillaria (Piscicapillaria) freemani 28–29, 179–180
“Porrocaecum-type” larva–see **Pseudoterranova* sp.
Pseudancyracanthus –see *Cystidicola*
Pseudanisakis 8, 119
**Pseudanisakis* sp. 121, 180
**Pseudanisakis tricupola* 119–121, 179
Pseudocapillaria 8, 23, 30, 31
Pseudocapillaria (Ichthyocapillaria) salvelini 31–32, 189–190, 192–196
Pseudocapillaria (Pseudocapillaria) tomentosa 32–33, 183–187, 190–192, 194–195, 200, 208
Pseudocystidicola–see *Ascarophis*
Pseudodelphis 9, 40
Pseudodelphis oligocotti 41–42, 203, 208–210, 217–218
Pseudometabronema–see *Salvelinema*
Pseudoterranova 6–7, 9, 119, 121
**Pseudoterranova bulbosa* 124–125, 200, 209, 221, 223
**Pseudoterranova decipiens* 125–127, 179, 181–182, 189, 191–192, 194–195, 198–211, 216–223
**Pseudoterranova decipiens* C–see **Pseudoterranova bulbosa*
**Pseudoterranova* sp. 127–128, 179–180, 189, 193, 200–201, 205–209, 216–217, 219–223

Quimperiidae 16, 150, 171, 174

Quimperiinae 171

Raphidascarididae 7, 16

Raphidascaridinae 7, 121, 134, 146

Raphidascaridinea 134

Raphidascaris 9, 134, 146

Raphidascaris acus 137, 146–149, 180–181, 183–188, 190–191, 195–197, 200, 202–203, 208, 210–215

**Raphidascaris acus* 148–150

Raphidascaris alius–see *Raphidascaris acus*

Raphidascaris canadensis–see *Raphidascaris acus*

Raphidascaris laurentianus–see *Raphidascaris acus*

***Raphidascaris* sp. 150

Rhabditida 16, 34–35

Rhabdochona 9–10, 66–67

Rhabdochona canadensis 67–68, 181, 183, 185–188, 192, 195, 197, 210, 215

Rhabdochona cascadii 66, 68–70, 180–188, 191–197, 200, 212–214

Rhabdochona catostomi 70–71, 187

Rhabdochona cotti 71–73, 208

Rhabdochona decaturensis 73–74, 183–184, 188–189

Rhabdochona kisutchi 73–76, 192–194, 196

Rhabdochona laurentiana–see *Rhabdochona ovifilamenta*

Rhabdochona milleri 76–77, 185–187, 191–195

Rhabdochona ovifilamenta 77–79, 185–186, 188, 191–196, 214

Rhabdochona rotundicaudatum 79–80, 183–184, 186, 188, 212–213

***Rhabdochona* sp. 68, 82, 183–188, 190, 192–197, 202, 209, 211–214

Rhabdochona zacconis 80–82, 187

Rhabdochonidae 16, 66

Rhabdochonidae gen. sp. 82, 180

Salmonema 9, 84, 91, 100

Salmonema ephemeridarum 84, 100–102, 181, 185–186, 190–197, 208

Salmonema prevosti 102–103, 188

Salmonema sp. 102, 180

Salvelinema 9, 84, 102, 104
Salvelinema salmonicola 104–105, 192, 196
Salvelinema walkeri 105–106, 191–193
 Seuratiinae 115
 *Seuratiinae gen. sp. 119, 195
 Seuratoidea 5, 7, 16, 34, 119, 150
Skrjabinocapillaria bakeri—see *Pseudocapillaria (Pseudocapillaria) tomentosa*
Spinitectus 9–10, 84, 106–107
Spinitectus acipenseri 107–108, 180
Spinitectus carolini 108–110, 181, 183, 188–190, 197, 211–215
Spinitectus cristatus 107, 110, 199
 ***Spinitectus gracilis* 107, 110–111, 180, 183, 185, 187–190, 193–194, 196–197, 200, 209, 212–215
Spinitectus macrospinosus 112–114, 181, 188
Spinitectus sp. 114, 180–181, 198–199, 214–215
Spiroxys 9
 **Spiroxys contortus* 58–59, 188, 214
 **Spiroxys* sp. 58–59, 180, 183–188, 197, 202–203, 212–214
 *Spirurida gen. sp. 82, 182, 189, 193, 201, 220, 222
 Spiruridae 16
 *Spiruridae gen. sp. 83, 221, 223
 Spirurina 16, 36
 *Spirurinae gen. sp. 83, 210
 Spiruroidea 5, 16, 36, 82–83
 *Spiruroidea gen. sp. 83, 180
 Spiruromorpha 7, 16
Sterliadochona ephemeridarum—see *Salmonema ephemeridarum*
Sterliadochona tenuissima—see *Salmonema ephemeridarum*
 Syncuaria 9, 115
 *Syncuaria squamata 7, 115–118, 182

 **Terranova decipiens*—see **Pseudoterranova decipiens*
 Tetrameres 9
 *Tetrameres sp. 83, 114, 183
 Tetrameridae 16, 83, 114
 Thelazioidea 5, 16, 36, 66
Thynnascaris—see *Hysterothylacium*
 ***Thynnascaris adunca*—see ***Hysterothylacium aduncum*
 ***Thynnascaris brachyura*—see ***Hysterothylacium brachyurum*
Thynnascaris incurva—see *Hysterothylacium incurvum*
Thynnascaris magna—see *Hysterothylacium magnum*
Thynnascaris melanogrammi—see *Hysterothylacium melanogrammi*
Thynnascaris reliquens—see *Hysterothylacium reliquens*
 Trichinellida 16–17, 21
 Trichinelloidea 6, 11, 16
 Trichosomoididae 5, 16, 21, 33–34
Truttaedacnitis 9, 150–152
Truttaedacnitis alpinus—see *Truttaedacnitis truttae*
Truttaedacnitis clitellarius 152–153, 180
 ***Truttaedacnitis pybusae* 153–155, 178
Truttaedacnitis sphaerocephala 155–156, 180
Truttaedacnitis sp. 158, 184–186, 194–195
Truttaedacnitis stelmioides—see *Truttaedacnitis pybusae*
Truttaedacnitis truttae 156–158, 178, 185, 190–196

INDEX TO HOSTS

- Acipenser brevirostrum* 95, 180
Acipenser fulvescens 64, 70, 82, 95, 102, 107, 111, 114, 149–150, 153, 180
Acipenser oxyrinchus [oxyrinchus] 95, 155, 180
Acipenser transmontanus 22, 82–83, 123, 177, 180
Acrocheilus alutaceus 57, 70, 182
Alepocephalus agassizi [agassizii] 123, 190
Alosa aestivalis 123, 126, 146, 181
Alosa pseudoharengus 123, 126, 140, 146, 182
Alosa sapidissima 90, 140, 182
Ambloplites rupestris 18, 20, 26, 58, 63, 70, 79, 82, 110, 111, 131, 137, 146, 149, 168, 177, 212
Amblyraja radiata 120–121, 123, 126, 127, 131, 179
Ameiurus melas 82, 166, 168, 188
Ameiurus nebulosus 18, 20, 26, 58, 63, 70, 79, 82, 102, 110–111, 131, 166, 168, 177, 188
Amia calva 110, 173, 181
Ammocrypta pellucida 63, 177, 213
Ammodytes dubius 123, 140, 218
Ammodytes hexapterus 123, 131, 218
Anarhichas lupus 26, 90, 126, 140, 218
Anguilla rostrata 36, 37, 39, 100, 114, 131, 137, 176, 181
Anoplarchus purpureus 44, 90, 123, 127, 131, 217
Anoplopoma fimbria 26, 126, 127, 177, 207
Apeltes quadracus 97, 115, 126, 131, 203
Aplodinotus grunniens 20, 46, 50, 63, 111, 168, 177, 215
Apodichthys flavidus 26, 42, 124, 144, 217
Argentina silus 123, 189
Artediellus atlanticus 126, 208
Artedius harringtoni 26, 90, 131, 208
Artedius lateralis 42, 208
Aspidophoroides monopterygius 126, 210
Atheresthes stomias 82, 123–124, 126–127, 140, 220
Aulorhynchus flavidus 50, 90, 124, 131, 140, 202
- Bathyraja interrupta* 28, 179
Blepsias cirrhosus 124, 131, 210
Boreogadus saida 88, 123, 126, 128, 146, 199
Brosme brosme 123, 126, 199
- Carassius auratus* 57, 115–116, 118, 177, 182
Carpionomoxys cyprinus 53, 62–63, 70, 76, 186
Catostomus commersoni 20, 32, 50, 52–53, 70, 79, 82, 97, 148, 177, 186
Catostomus columbianus 146, 187
Catostomus commersonii 20–21, 32, 48, 50, 52–54, 57–58, 63, 68, 70, 79, 82, 111, 148–149, 177, 187
Catostomus macrocheilus 21, 32, 52, 58, 66, 70, 82, 187
Catostomus platyrhynchus 79, 187
Centrarchidae gen. sp. 168, 212
Chitonotus pugetensis 26, 131, 208
Chrosomus eos 68, 70, 114, 131, 148, 177
Citharichthys sordidus 124, 219
Citharichthys stigmaeus 124, 131, 219
Clinocottus acuticeps 177, 208
Clupea harengus 123–124, 126, 128, 140, 182
Clupea pallasii 60, 82, 123–124, 126, 131, 140, 177, 182
Coregonus artedii 50, 54, 57, 97, 99–100, 111, 137, 148–150, 190
Coregonus clupeaformis 32, 50, 54, 57, 82, 97, 99–100, 110–111, 131, 146, 148–150, 158, 177, 190
Coregonus hoyi 97, 99, 190
Coregonus huntsmani 123, 126, 191
Coregonus kiyi 99, 191
Coregonus nasus 90, 97, 150, 191
Coregonus nigripinnis 97, 191

Coregonus reighardi 97, 99, 191
Coregonus sardinella 177, 191
Coryphaenoides rupestris 124, 131, 140, 177, 198
Coryphopterus nicholsi [*Rhinogobiops nicholsii*] 131, 218
Cottunculus microps 146, 211
Cottus aleuticus 90, 146, 208
Cottus asper 21, 32, 44, 73, 100, 208
Cottus bairdi [*bairdii*] 63, 73, 131, 149, 208
Cottus cognatus 21, 73, 82, 111, 149, 173, 208
Cottus caeruleomentum 73, 208
Couesius plumbeus 32, 68, 70, 82, 183
Cryptacanthodes giganteus 26, 124, 140, 217
Cryptacanthodes maculatus 126, 217
Culaea inconstans 20, 58, 63, 70, 131, 137, 146, 177, 203
Cyclopterus lumpus 123–124, 126, 133, 211
Cymatogaster aggregata 124, 131, 163, 170, 177, 215
Cyprinella spiloptera 63, 70, 177, 183
Cyprinus carpio 32, 110, 111, 177, 183
Cyprinus carpio x *Carassius auratus* 32, 183

Dipturus laevis 121, 124, 179
Dorosoma cepedianum 177, 182

Enchelyopus cimbrius 126, 199
Entosphenus tridentatus 21, 178
Eopsetta exilis [*Lyopsetta exilis*] 124, 131, 222
Eopsetta jordani 124, 131, 140, 220
Errex zachirus [*Glyptocephalus zachirus*] 124, 140, 220
Esox americanus americanus 97, 197
Esox americanus vermiculatus 168, 197
Esox lucius 57, 63–64, 68, 99, 110, 112, 131, 137, 148–150, 177, 197
Esox masquinongy 100, 137, 148, 197
Esox niger 50, 197
Etheostoma blennioides 63, 213
Etheostoma caeruleum 79, 82, 149, 213
Etheostoma exile 63, 70, 82, 137, 149, 177, 213
Etheostoma microperca 131, 214
Etheostoma nigrum 58, 70, 131, 149, 166, 177, 214
Eumesogrammus praecisus 126, 217
Eumicrotremus spinosus 126, 211

Fundulus diaphanus 20, 58, 63, 82, 99, 114, 146, 149, 163, 177, 202
Fundulus heteroclitus 115, 126, 131, 133, 202

Gadus macrocephalus 90, 123–128, 133, 140, 199
Gadus morhua 26, 86, 88, 90, 123–124, 126–128, 131, 133, 140, 146, 160, 177, 200
Gadus ogac [*Gadus macrocephalus*] 90, 123–128, 133, 140, 199
Gasterosteus aculeatus 21, 42, 54, 90, 115, 124, 126, 131, 146, 177, 203
Glyptocephalus cynoglossus 90, 123–124, 126–128, 131, 133, 140, 177, 220
Glyptocephalus zachirus 124, 140, 220
Gobiesox maeandricus 42, 44, 58, 177, 218

Hemilepidotus hemilepidotus 26, 90, 209
Hemitripterus americanus 86, 123, 126, 210
Hexagrammos decagrammus 90, 177, 207
Hexagrammos lagocephalus 26, 90, 124, 131, 207
Hiodon alosoides 68, 114, 148–149, 177, 181
Hiodon tergisus 63, 70, 100, 181
Hippoglossoides elassodon 124, 131, 140, 220
Hippoglossoides platessoides 26, 86, 123–124, 126–128, 131, 133, 140, 176–177, 220
Hippoglossus hippoglossus 26, 123–128, 131, 140, 160, 221

Hippoglossus stenolepis 24, 29, 82–83, 88, 123, 126, 131, 140, 163, 177, 221
Hydrolagus colliei 131, 179
Hyptelium nigricans 50, 187
Hypomesus pretiosus 131, 140, 189

Icelinus filamentosus 131, 209
Icosteus aenigmaticus 124, 218
Isopsetta isolepis 124, 221
Ictalurus punctatus 20, 63, 112, 114, 149, 177, 188

Jordania zonope 131, 209

Labidesthes sicculus 63, 177, 202
Lampetra appendix [*Lethenteron appendix*] 155, 178
Lampetra tridentata [*Entosphenus tridentatus*] 21, 178
Lepidopsetta bilineata 26, 44, 58, 124, 163, 221
Lepisosteus osseus 58, 97, 180
Lepomis gibbosus 18, 20–21, 50, 58, 63, 82, 110, 112, 131, 137, 149, 168, 177, 212
Lepomis macrochirus 63, 82, 110, 146, 168, 212
Leptoclinus maculatus 126, 217
Leptocottus armatus 42, 124, 131, 144, 209
Lethenteron appendix 155, 178
Leucoraja erinacea 121, 179
Leucoraja ocellata 121, 124, 127, 179
Limanda ferrugineus 123, 126–128, 131, 133, 140, 163, 221
Liparis dennyi 88, 211
Lophius americanus 123, 126–127, 201
Lota lota 21, 32, 63, 70, 112, 137, 148–149, 168, 173, 177, 200
Lumpenus lumpretaeformis 126, 217
Lumpenus maculatus [*Leptoclinus maculatus*] 126, 217
Luxilus cornutus 58, 70, 73, 79, 82, 112, 131, 168, 183
Lycodes brevipes 26, 124, 216
Lycodes corteziensis 131, 216
Lycodes esmarki [esmarkii] 146, 216
Lycodes lavalaei 45, 216
Lycodes reticulatus 126, 216
Lycodes vahli [vahlii] 45, 126, 216
Lycodon mirabilis 146, 216
Lyopsetta exilis 124, 131, 222

Macrhybopsis storeriana 177, 183
Macrourus berglax 26, 114, 124, 140, 146, 198
Macrozoarces americanus [*Zoarces americanus*] 86, 123, 126, 132, 177, 216
Malacocottus kincaidii 26, 131, 211
Mallotus villosus 82, 90, 123–124, 126, 128, 131, 133, 140, 146, 177, 189
Margariscus margarita 68, 70, 183
Melanogrammus aeglefinus 28, 86, 123–124, 126–127, 131, 133, 140, 144, 146, 160, 200
Menidia menidia 126, 202
Merluccius albidus 26, 124, 140, 198
Merluccius bilinearis 26, 86, 123–124, 126, 140, 146, 177, 198
Merluccius productus 123–124, 126, 131, 140, 198
Microgadus tomcod 36–37, 86, 123–124, 126–127, 140, 177, 201
Micropterus dolomieu 20, 26, 50, 58, 63, 70, 82, 110, 112, 131, 137, 148, 168, 177, 213
Micropterus salmoides 18, 50, 63, 110, 131, 137, 168, 177, 213
Microstomus pacificus 82, 90, 124, 126, 140, 160, 222
Morone americana 20, 110, 131, 146, 168, 211
Morone chrysops 20, 58, 64, 82, 110, 149, 150, 168, 177, 211
Morone saxatilis 50, 212
Moxostoma anisurum 68, 112, 131, 137, 149, 187
Moxostoma erythrurum 76, 188
Moxostoma macrolepidotum 52, 70, 76, 188

Mylocheilus caurinus 21, 27, 32, 70, 82, 158, 183
Myoxocephalus aenaeus 126, 209
Myoxocephalus octodecemspinosus 26, 86, 123–124, 126–127, 131, 133, 209
Myoxocephalus polyacanthocephalus 26, 90, 124, 127, 131, 209
Myoxocephalus quadricornis 125, 209
Myoxocephalus scorpius 123, 126, 128, 133, 140, 177, 209
Myoxocephalus thompsoni [*thompsonii*] 83, 99, 149, 210

Nautichthys oculofasciatus 90, 210
Nezumia bairdi [*bairdii*] 26, 123, 126, 133, 140, 146, 198
Nocomis biguttatus 70, 79, 82, 184
Nocomis micropogon 79, 177, 184
Notemigonus crysoleucas 64, 70, 82, 137, 149, 177, 184
Notropis anogenus 70, 184
Notropis atherinoides 64, 82, 131, 137, 177, 184
Notropis buccatus 64, 184
Notropis heterodon 64, 177, 184
Notropis heterolepis 58, 64, 184
Notropis hudsonius 58, 64, 70, 73, 82, 112, 115, 131, 149, 177, 184
Notropis stramineus 64, 70, 185
Notropis volucellus 70, 185
Noturus flavus 64, 68, 73, 112, 114, 137, 188
Noturus gyrinus 73, 189

Oligocottus maculosus 42, 124, 131, 177, 210
Oncorhynchus clarki [*clarkii*] 21, 32, 57, 70, 76, 100, 105, 131, 158, 177, 191
Oncorhynchus gorbuscha 57, 90, 97, 99, 123–124, 131, 140, 148, 177, 191
Oncorhynchus keta 105, 123–124, 131, 140, 177, 191
Oncorhynchus kisutch 21, 26, 32, 54, 57, 64, 76, 82, 90, 97, 99, 100, 105, 124, 131, 140, 163, 177, 192
Oncorhynchus mykiss 20, 21, 27, 32, 54, 57, 68, 70, 76, 82, 95, 97, 99, 101, 105, 115, 123, 126, 128, 131, 140, 146, 148, 158, 173, 177, 192
Oncorhynchus nerka 26, 54, 57, 70, 76, 82, 90, 97, 99, 101, 112, 124, 127, 131, 140, 146, 158, 177, 193
Oncorhynchus tshawytscha 26, 57, 82, 97, 99, 105, 123–124, 128, 131, 177, 193
Ophiodon elongatus 124, 126–127, 131, 140, 144, 163, 177, 207
Osmerus mordax 26, 32, 50, 54, 86, 97, 99, 110, 112, 115, 124, 126–127, 146, 189

Paraplagusia bilineata 26, 44, 58, 124, 163, 222
Parophrys vetulus 26, 29, 44, 90, 124, 131, 140, 160, 163, 222
Peprilus triacanthus 123, 126, 219
Perca flavescens 18, 20–21, 46, 50, 58, 64, 70, 79, 82, 97, 110, 112, 114, 131, 137, 148–150, 163, 168, 177, 214
Percina caprodes 64, 112, 131, 150, 177, 214
Percina copelandi 64, 214
Percina maculata 64, 214
Percopsis omiscomaycus 64, 68, 70, 82, 112, 137, 150, 177, 197
Petromyzon marinus 158, 178
Pholis gunnellus 86, 217
Pholis laeta 42, 44, 50, 124, 131, 217
Pholis ornata 42, 44, 124, 131, 217
Phoxinus eos [*Chrosomus eos*]
Phoxinus neogaeus [*Chrosomus neogaeus*]
Phycis chesteri 110, 123, 126, 140, 199
Pimephales notatus 58, 70, 150, 177, 185
Pimephales promelas 82, 131, 150, 185
Platichthys stellatus 44, 50, 58, 124, 131, 160, 163, 177, 222
Platygobio gracilis 68, 185
Pleuronectes americanus Walbaum [*Pseudopleuronectes americanus* Walbaum] 86, 123, 126–128, 131, 133, 140, 163, 177, 222
Pleuronectes bilineatus [*Paraplagusia bilineata*]
Pleuronectes ferrugineus [*Limanda ferrugineus*] 123, 126–128, 131, 133, 140, 163, 221
Pleuronectes isolepis [*Isopsetta isolepis*] 124, 221
Pleuronectes putnami 127–128, 131, 222

Pleuronectes vetulus [*Parophrys vetulus*] 26, 29, 44, 90, 124, 131, 140, 160, 163, 222
Podothecus accipenserinus 131, 140, 210
Poecilia reticulata 130–131, 202
Pollachius virens 123–124, 126, 128, 146, 160, 201
Pomoxis annularis 177, 213
Pomoxis nigromaculatus 64, 110, 112, 213
Prosopium coulteri [*coulterii*] 76, 97, 99, 193
Prosopium cylindraceum 21, 32, 50, 54, 57, 97, 99, 101, 112, 158, 177, 193
Prosopium williamsoni 21, 32, 54, 57, 70, 76, 82, 97, 99, 101, 128, 146, 158, 173, 177, 193
Psettichthys melanostictus 124, 222
Pseudopleuronectes americanus 86, 123, 126–128, 131, 133, 140, 163, 177, 222
Psychrolutes sigalutes 124, 211
Ptychocheilus oregonensis 21, 27, 32, 58, 70, 82, 131, 146, 150, 158, 185
Pungitius pungitius 115, 131, 133, 150, 203

Raja [*Leucoraja*] *erinacea* [*Leucoraja erinacea*] 121, 179
Raja laevis [*Dipturus laevis*] 121, 124, 179
Raja ocellata [*Leucoraja ocellata*] 121, 124, 127, 179
Raja radiata [*Amblyraja radiata*] 120, 121, 123, 126–127, 131, 179
Raja rhina 28, 124, 179
Raja stellulata 28, 180
Reinhardtius hippoglossoides 86, 88, 90, 123–126, 128, 131, 133, 140, 177, 223
Rhamphocottus richardsoni [*richardsonii*] 90, 127, 208
Rhinichthys atratulus 70, 131, 185
Rhinichthys cataractae 58, 64, 68, 70, 76, 101, 158, 185
Rhinochimaera atlantica 140, 179
Rhinogobiops nicholsii 131, 218
Rhodymenichthys dolichogaster 58, 218
Richardsonius balteatus 32, 58, 70, 82, 158, 185
Ronquilus jordani 124, 163, 216

Salmo salar 32, 54, 64, 101, 123–124, 126, 128, 131, 140, 150, 177, 194
Salmo trutta 97, 101, 194
Salvelinus alpinus 32, 54, 57, 97, 99, 101, 123–124, 126, 131, 133, 141, 158, 177, 194
Salvelinus fontinalis 21, 32, 46, 50, 54, 57, 70, 76, 79, 82, 97, 99, 101, 112, 115, 119, 123–124, 126, 131, 141, 146, 148, 150, 158, 177, 195
Salvelinus malma 21, 32, 54, 57, 68, 76, 82, 97, 101, 105, 131, 137, 146, 158, 173, 177, 195
Salvelinus namaycush 21, 32, 54, 57, 97, 99, 101, 112, 137, 141, 150, 158, 177, 196
Sander canadensis 21, 64, 137, 150, 215
Sander vitreus 20, 21, 46, 64, 68, 97, 110, 112, 114, 131, 137, 148, 150, 168, 177, 215
Scomber scombrus 123–124, 141, 146, 219
Scomberesox saurus 123, 202
Scophthalmus aquosus 123, 126–128, 131, 219
Scorpaenichthys marmoratus 24, 92, 210
Sebastes aleutianus 131, 141, 163, 204
Sebastes alutus 26, 90, 124, 126, 131, 141, 163, 204
Sebastes babcocki 26, 141, 163, 204
Sebastes borealis 26, 90, 132, 163, 204
Sebastes brevispinis 124, 132, 141, 204
Sebastes caurinus 26, 90, 132, 141, 163, 204
Sebastes ciliatus 132, 204
Sebastes crameri 132, 141, 163, 204
Sebastes diploproa 90, 132, 141, 204
Sebastes elongatus 132, 205
Sebastes entomelas 132, 141, 205
Sebastes fasciatus 123–124, 126, 128, 132–133, 141, 205
Sebastes flavidus 26, 90, 124, 126–127, 132, 141, 163, 205
Sebastes goodei 132, 205
Sebastes helvomaculatus 132, 141, 205
Sebastes maliger 26, 90, 132, 141, 163, 205
Sebastes mentella 123–124, 126, 128, 132–133, 141, 205

Sebastes nebulosus 90, 92, 132, 141, 163, 177, 205
Sebastes nigrocinctus 26, 132, 206
Sebastes norvegicus 124, 126–128, 132, 141, 206
Sebastes paucispinis 26, 124, 132, 141, 163, 206
Sebastes pinniger 124, 132, 141, 206
Sebastes polyspinis 132, 141, 206
Sebastes proriger 90, 132, 141, 206
Sebastes reedi 132, 141, 206
Sebastes ruberrimus 26, 90, 132, 141, 163, 206
Sebastes variegatus 90, 132, 141, 207
Sebastes wilsoni 132, 207
Sebastes zacentrus 90, 132, 141, 207
Semotilus atromaculatus 58, 68, 70, 79, 82, 115, 177, 186
Semotilus corporalis 68, 70, 186
Squalus acanthias 121, 123, 124, 127, 132, 179
Syngnathus leptorhynchus 42, 124, 132, 203
Synaphobranchus kaupi [kaupii] 132, 146, 181

Tautoglabrus adspersus 124, 126, 127, 132, 133, 141, 171, 177, 215
Thaleichthys pacificus 132, 190
Theragra chalcogramma 82, 123, 124, 127, 128, 132, 133, 141, 201
Thunnus alalunga 124, 219
Thymallus arcticus 32, 57, 97, 99, 101, 150, 177, 196
Tinca tinca 150, 186
Triglops murrayi 126, 210
Triglops pingeli [pingelii] 124, 126, 132, 210

Umbra limi 58, 150, 197
Urophycis chesteri [Phycis chesteri] 110, 123, 126, 140, 199
Urophycis chuss 26, 110, 123, 124, 126, 141, 199
Urophycis tenuis 26, 86, 110, 114, 123, 124, 126, 128, 133, 141, 160, 199

Xiphias gladius 66, 123, 135, 141, 142, 144, 145, 177, 219
Xiphister atropurpureus 44, 217

Zoarcetes americanus 86, 123, 126, 132, 177, 216

 Unspecified hosts:
 “cod” 126, 127, 177, 201
 “dace” 101, 186
 “fish” 20, 82, 83, 123–128, 132, 223
 “flounder” 177, 223
 “hake” 126, 198
 “herring” 124, 132, 177, 182
 “salmonids” 101, 196
 “sculpin” 177, 210